

The Pennsylvania Deer Problem

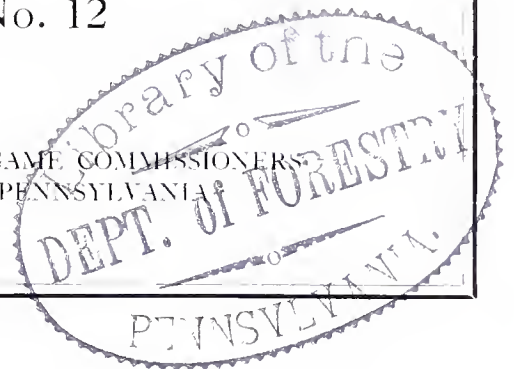


WHITE-TAILED DEER, FEEDING IN AN OPEN FIELD

Thousands of these graceful animals feed regularly upon the twigs and buds of fruit trees in Pennsylvania orchards.

Bulletin No. 12

ISSUED BY THE BOARD OF GAME COMMISSIONERS
COMMONWEALTH OF PENNSYLVANIA



Duplicate in 7.3

BOARD OF GAME COMMISSIONERS

ROSS L. LEFFLER, McKeesport, *President*

JARED M. B. REIS New Castle, *Vice-President*

FRANCIS H. COFFIN, Scranton

RICHARD E. REITZ, Brookville

ADOLF MÜLLER, Norristown

HARRY C. STACKPOLE, St. Marys

FRANKLIN G. McINTOSH, Franklin

J. AUG. BECK, Williamsport

JOHN J. SLAUTTERBACK, Harrisburg, *Executive Secretary*



Photo by District Game Protector Rollin
Heffelfinger, Honesdale, Pa.

INQUISITIVE, YET ALERT, THE WHITE-TAIL BUCK
STANDS AT THE EDGE OF HIS FOREST HOME.

FOREWORD

The demand for the original *Bulletin No. 12*, on “*The Pennsylvania Deer Problem*,” has been so great the first edition of ten thousand copies is now exhausted. Therefore PART 1 of this bulletin consists of a reprint of this former *Bulletin No. 12*, and PART 2 takes up the account at the point where the original *Bulletin No. 12* leaves off.

The situation is even more critical now than when the original bulletin was issued, and the citizens of the State, and especially sportsmen, farmers, orchardists and those interested in the forests of Pennsylvania, will wish to know what the present situation is, and what attempts are being made to cope with our deer problem.

Those interested in the relation of the deer problem to the problem of reforestation should send to the Department of Forests and Waters for *Research Circular 3*, by LeRoy Frontz, *Deer Damage to Forest Trees in Pennsylvania*.

This damage to the forests is only one of many serious phases of what is probably the most baffling problem ever faced by the Game Commission. Even to convert — within a single generation — a “shot-out” eastern state into a state overflowing with game, was a simple problem compared with this problem of feeding and controlling certain species of this game after we have it; and it has long since passed the point where it was a problem for sportsmen and the Game Commission only, it has become a matter of importance to the citizens of the state in general.



Digitized by the Internet Archive
in 2015

THE PENNSYLVANIA DEER PROBLEM

INTRODUCTION

The White-tailed Deer is today Pennsylvania's most striking game animal. Herds of the graceful creatures bound across the open fields bordering our woodlands; farmers and fruit growers see the animals regularly about their farms and orchards; during the big game season hundreds of automobiles, their fenders laden with venison, pass through our mountain towns, bearing the happy hunters homeward.

Pennsylvania has awakened during the past few years to the fact that she has too many deer. The Board of Game Commissioners, acting for the sportsmen of Pennsylvania, have realized that the deer herd must be reduced. After attempting many methods of improving the situation they decided in 1928 to declare for the first time since 1907 a general season on antlerless deer. This declaration aroused so much antagonism that the controversy echoed in the Nation's press from ocean to ocean.

Those who have heard only the opinions of men opposed to the Board's action are certain to have inadequate knowledge of the situation. The present bulletin is written to acquaint the citizens of Pennsylvania with the history and present status of the deer herd in this state. Facts concerning the complete life-history of the animal in Pennsylvania will appear in a subsequent bulletin. We trust that the statements set forth herein concerning but one of our game animals will give the reader some conception of the vastness of the problem of managing a state's wild life.

BRINGING BACK THE DEER HERD

When the Board of Game Commissioners was appointed in 1896, deer were so rare in Pennsylvania that the appearance of one of the fleet-footed creatures caused considerable comment. Mismanagement of forests, market hunting, imperfect laws, and lack of law enforcement, had led to a virtual extermination of our deer. The newly-appointed Board, being interested particularly in our big game, took immediate steps toward protection of deer. In 1897 a law was passed forbidding the use of hounds in hunting deer and measures were adopted which later led to the stopping of all market hunting. The killing of deer at salt licks was outlawed. In 1905 the first game refuge law was passed. This gave deer sanctuaries where they could propagate unmolested and where for all time they could live without fear of being pursued by hunters. This one move meant that Pennsylvania deer would probably never be exterminated.

In 1907 a drastic step was taken when the "Buck Law" was enacted. This law protected all deer save those with visible antlers. There was a storm of protest against the law. Most hunters felt that they could not possibly distinguish the sexes in the field and that if they wished certainly to avoid the payment of a fine they would simply not get any deer at all. While the law was passed primarily because conservationists of that period realized that protection of does would mean a re-establishment of the deer herd, the chief verbal argument for the law, nevertheless, was that necessity for determining the sex of the animal shot in the woods would mean a saving of human life. Had this argument not been put forth there is a possibility that the law might not have been passed. In the words of Dr. Joseph Kalbfus who was for so many years Executive Secretary of the Board, "The law forbidding the killing of any but a male deer with horns was passed more to protect human life than to protect deer." Not for years did the protest against this law subside. Even until 1913 requests for its repeal were made.

Other legislation, such as the Automatic Gun Law of 1907, the Alien Gun Law of 1909, and the subsequent Alien Dog Law of 1915, all helped indirectly to increase the size of the deer herd. The Resident Hunters' License Law of 1913 gave the Board additional funds with which to work. Very little money was used, however, in purchasing deer from other states for stocking purposes, and only about 700 animals were brought in from Vermont, Michigan, Ohio, North Carolina, and other localities.

Since the original "Buck Law" of 1907, several modifications have been effected. The deer season in 1907 extended from November 15 to December 1. In 1909 legal deer were characterized as those which possessed "horns visible above the hair." In 1913 the season was changed to November 10 to 25, and the law protected all deer save males with horns two inches above the hair. Since 1915 the regular deer season has been from December 1 to 15. In 1921 the regular deer season was the same as previously, but all deer were protected save "male deer with antlers extending four inches above the skull." In 1923 legal deer were "males with antlers six inches or more in length, measuring from the top of the skull as the deer is in life," and in 1925 only "male deer having two or more points to the antler" were considered legal. This latter provision remained in effect until the present year, when the season on male deer was closed for the first time in the history of the Board.

A remarkable thing to note about the whole situation since 1907, notwithstanding the opposition of a large number of deer hunters to the protection of female deer, is that the number of male deer continued to increase each year commensurately with the increase in

the number of hunters, in spite of the annual legal kill each season.

The Board had, since 1907, been interested chiefly in producing a large buck population; comparatively little attention was paid to the female animals because they were obviously holding their own and producing consistently large numbers of fawns. When the Board began to hear rumors of considerable damage to crops and orchards, however, they suddenly realized that the deer herd, the doe herd in particular, was reaching vast proportions. If the age of a deer in a relatively ideal habitat may be considered to be twenty years, and if the average doe may, as some authorities assert, produce fawns every year for sixteen years of her life, then a little arithmetical computation will give some idea as to the possible size of the doe herd in Pennsylvania after virtually twenty years of constant protection of the female animals. Relatively few of the does living in 1907, when the "Buck Law" was passed, had by 1920 died a natural death. Many of them might still have been actually producing fawns, and the innumerable female progeny of these animals were by this time bringing forth young at such a rapid rate that Pennsylvania's remarkable buck kill during the regular season was receiving nation-wide notoriety.

How quickly the problem of the Board changed from one of saving the deer herd to one of adequately controlling it.

The farmers and fruit-growers, first to suffer from over-abundance of deer, were naturally first to sound the alarm. They demanded relief. They suggested payment for damage. Many farmers asked the logical question: Has any group of men interested in recreation in Pennsylvania the right to impose upon the citizens of the State a system which will force any landowner to desert his farm because damage by wild animals protected as game is so extensive?

After the Board made careful inquiry into the situation they realized that while some deer damage was overestimated many complaints were justified. They knew that something would have to be done to prove that the sportsman was interested in the farmer's problems and eager to help him solve them. In 1923 the Deer-Proof Fence Law was passed, which provided that eight-foot wire fencing would be furnished to farmers suffering damage providing the farmers would meet half the cost of construction, the Board of Game Commissioners meeting the other half. \$10,000 for each year was thus set aside from the Game Fund for deer-proof fencing. This law did not improve the situation widely, partly because the proposition was an expensive one. Not many farmers could afford the fence, and oftentimes the small landowner who most needed protection could least afford the fence. Also the fencing of certain property meant that nearby farms were subjected to even worse deer damage than before. In 1925 the law was clarified to permit landowners to furnish posts and erect the fence, the

Game Commission to furnish the wire and staples. Even with this improvement the law could not possibly remedy conditions very widely.

In 1923 a law was passed giving landowners the right to kill deer caught in the act of destroying property providing they dress the carcass and report the incident to the nearest Game Protector within twenty-four hours after killing. In 1925 this law was clarified to enable the landowners in sections where damage was acute to retain the venison for food.

Trapping deer for stocking elsewhere was attempted as a relief measure. Several operations of this sort were carried on in 1924 but only a few animals were caught and this method of reducing the deer herd was found to be so tedious, laborious and expensive that it could not be developed. Furthermore, there was considerable mortality among the deer caught in the traps.

Many sportsmen were so averse to any killing of female deer that the law passed in 1923 removing protection from does in sections where depredations were being committed, and necessitating a special license costing \$5.00, met with little favor. Of the 100 licenses issued in Washington and Quincy Townships, Franklin County, during a three day special season in 1923, only eight female deer were killed. Many sportsmen bought licenses which they never used; in 1924, during a three day special season, only 160 female deer were killed in Logan, West and Barre Townships of Huntingdon County, and Brown, Union and Menno Townships of Mifflin Counties, when 456 licenses were issued.

In 1925 irregular portions of six counties, more or less regardless of township boundaries, were declared as doe areas. These separate areas were located in Franklin, Perry, Adams, Cumberland, Mifflin and Huntingdon Counties. In all these areas a total of 10,650 licenses were offered, 5,513 were taken out by sportsmen, and 1,029 does were killed. In 1925, the Special Deer License Law was amended to reduce the license fee from five to two dollars.

In 1926 a doe season was declared in one large portion of Clearfield County, three sections of Huntingdon County, and two sections of Monroe County, and in all these areas 1,295 does were taken, 7,200 licenses were offered, and 5,060 were taken out.

In 1927, due chiefly to the fact that the sportsmen had not properly cooperated in the doe seasons which had been declared, special agents of the Board, known for their superior marksmanship and knowledge of deer hunting, were detailed to kill off a number of the older female animals, most of which were believed to be beyond breeding age. This action also engendered protest. Many felt that the Game Commission was depriving them of sport and meat which should rightfully belong to the hunters who had annually paid their license fee and who had, generally speaking, obeyed the law.

That everything possible was being done by the Board to relieve damage to crops and orchards was evidenced by the number of conferences and meetings which were held for the sole purpose of arriving at some solution mutually agreeable to sportsmen and landowners. Among these the conference on **Damage by Game**, held in the Senate Caucus Room of the State Capitol, on October 9, 1924, was of vast importance. Representatives from farming and fruit-growing communities, sportsmen's organizations, the Department of Agriculture, State Grange, State Horticultural Association, and the Board of Game Commissioners were on hand to discuss the proposition. A full-day trip was made into the South Mountain belt to study conditions, and much was learned from this experience. While many of those present offered various solutions previously tried out (such as deer-proof fences, trapping, and so forth), **the majority favored a special season on does** to remove the animals from affected sections.

During the 1927 General Assembly a bill was presented asking that \$100,000 be set aside from the Game Fund to pay claims of landowners for damage done by deer. The Board, sensing the impossibility of such procedure, succeeded in preventing the passage of this bill. They made a solemn promise, however, to do everything in their power to relieve overcrowded conditions in the deer herd. With this one thought in mind they decided, after careful study, to close the season on male deer during 1928, and declare a State-wide season for antlerless deer weighing 50 pounds or more with entrails removed. This was done in compliance with the act of May 14, 1925, P. L. 752, which provides that:

Section 509:

"When.....game animals.....are materially destroying property, or otherwise becoming a nuisance, or the sexes are not balanced properly, or the natural food supply is insufficient.....in any section..... the Board may.....remove or have removed such animals.....declare additional open seasons.....for the killing of game.....in any county or part thereof....."

Section 511:

"If satisfied that conditions warrant, may declare any section of the Commonwealth open to the killing of deer without visible antlers.....by residents of the Commonwealth during a special season of such length as the Board may deem advisable, either prior to or following the regular open season....."

According to a statement made public by the Board, the 1928 season on antlerless deer was declared for the following reasons:

First, to thin out deer in the over-crowded districts as effectively as possible and at the same time to take enough deer from all sections of the Commonwealth to prevent the over-crowding of any additional areas, and to prevent destruction of food and cover for other valuable game.

Second, to relieve deer damage as widely as possible so that no locality could complain that it had been discriminated against.

Third, to so stir up the deer herd as to put a stop to the semi-domestication of the animals. Deer had become so tame in many sections as to be uninteresting from the sporting standpoint and even dangerous to motorists and passersby.

Fourth, to forestall criticism which has always resulted from the opening of certain areas to heavy hunting for a short period, and at the same time to give hunters in every section an equal opportunity to get a deer.

Fifth, because at the time of the withdrawal of the "Deer Damage" bill at the 1927 session of the General Assembly a promise was made to the Game Committee of the House of Representatives that some certainly effective measure would be adopted to relieve widely the damage done by deer.

Sixth, to balance the sexes in the deer herd. Does had been protected for so long that there were too many of them. A State-wide season on both sexes was unsafe for the hunters; any State-wide season which would materially reduce the number of bucks was unnecessary; but does, which had been protected almost constantly since 1907, and which, as the mothers, were chiefly responsible for the rapidity of increase in the deer herd, had to be thinned out. An improper ratio between the sexes existed in all parts of the Commonwealth and this error, therefore, required wide-spread correction.

Seventh, to prevent the spreading of communicable diseases between deer and domestic stock. Deer were so abundant, so widely spread over the State, so rapidly becoming semi-domesticated, and were mingling so extensively with domestic stock, that there was danger of the spreading of such diseases, and preventive measures were imperative.

No sooner had the Board declared their intentions concerning the State-wide doe season than sportsmen almost everywhere were up in arms. Many sincerely believed that the does would be wiped out at one stroke.

Many were so uninformed as to the facts concerning the history of deer protection in Pennsylvania they did not realize that the steady increase of bucks every year since 1907 meant an equal increase in does **from which no animals had been taken.** So many believed that the Board's action meant the extermination of our deer, and there was so much controversy about the matter, that a decision from the Attorney General as to the season was again requested. The Attorney General declared that the State-wide open season on antlerless deer was not legal and that the Board would have to rescind their ruling and declare a Special Season for which a fee of \$2.00 in addition to the regular Resident Hunter's License Fee was necessary. Had there not been so much opposition to the Board's original ruling there would, in all probability, have been no Special Season, and no additional \$2.00 fee.

The Board's next step was to follow the Attorney General's ruling by declaring a Special Season on antlerless deer (of not less than fifty pounds in weight with entrails removed) with an additional

special license fee of \$2.00. Being aware of the opposition of those who believed that a general open season might mean the virtual extermination of deer in some sections, the Board decided to issue these special licenses only in counties where legal bucks were taken in 1927, in a ratio of eight special **paid** licenses to each legal buck deer killed in that County, according to the official record on file in the offices of the Board at Harrisburg of game killed in 1927. This ruling meant that in Allegheny County, where two legal bucks were taken in 1927, 16 special licenses were granted in 1928. Under this ruling only 54 of the 67 counties of the Commonwealth were open to deer hunting during 1928.

The law governing the regulations of the Special Season provides the issuing of Special Free Licenses to persons who reside upon and cultivate lands within the Commonwealth to hunt for deer upon these lands. The law also prohibits the issuing of any special deer license to non-resident hunters.

With the inauguration of the special season the Board was faced with the problem of reimbursing those hunters who had already secured their regular resident licenses with the understanding that they would be permitted to hunt deer under such licenses. This necessitated advising immediately all those who took out licenses prior to the ruling of the Attorney General on August 7. Everything possible in the way of information and instructions concerning the special season was placed before the sportsmen through the public press and through circulars sent out by the Board.

While the Board, after making careful field studies, were convinced of the fairness of their action, they desired the opinion of some dependable naturalist not residing in Pennsylvania and therefore asked Mr. Vernon Bailey of Washington, D. C., for years an official of the Biological Survey, to come to Pennsylvania to make a study of the deer situation. Mr. Bailey wrote a full report on his findings, a copy of which may be secured upon request at the offices of the Board at Harrisburg.

On Mr. Bailey's first visit to Pennsylvania he confined his investigations to those counties where deer conditions were known to be worst. Among the hundreds of dead deer which were found during his investigations most proved to be last year's fawns, with only a few two-year olds. Over a thousand dead fawns were found in four townships of northwestern Clearfield County. Around refuge No. 34 in Elk and Clearfield Counties 46 dead deer were counted, and out of this number only one was a two-year old. Mr. Bailey stated that the number of deer which died in Pennsylvania during the past spring could not even be roughly estimated, but it was far too great and the fact that most of those lost were fawns was significant. All of the dead deer ex-

amined were greatly emaciated, but none showed signs of injury or disease. Mr. Bailey felt that the deer range in Pennsylvania was considerably overstocked with animals, and he recommended that many of them be removed.

There were those, of course, who regarded Mr. Bailey's report as propaganda, pure and simple. Some even went so far as to state that the Board had paid him to make a report such as would justify their actions. Those who really know the impeccable honesty and justice of such a naturalist's work realized that he was perfectly sincere in offering the suggestion that in order to really remedy conditions **a great many deer should be removed from Pennsylvania.**

There were those, too, who felt that Mr. Bailey's report concerned only one part of the State, and demands for further study were so insistent that the Board asked him to make a special study of the situation in northeastern Pennsylvania. In this section he found, according to his report, far too many does. Once more he recommended that drastic measures be adopted which would eliminate our surplus animals.

One interesting fact concerning the situation is that while there was endless opposition to the action of the Board but one outstanding Pennsylvania naturalist took the trouble to make a personal investigation of the situation. This man was none other than John M. Phillips of Pittsburgh. Prior to Mr. Phillips' personal investigation he was not convinced that the Board were right, but after his careful study of conditions in the Clearfield County section he realized that the situation was more serious than he had thought.

In an open letter to the sportsmen he stated: "On my visits to that section [Clearfield County] this spring, I found conditions deplorable and almost beyond belief. The old deer, by standing on their hind legs, had eaten the edible food to a height of about 6 feet. The young deer, being unable to reach so high, were forced to feed on woody stems, bark and other indigestible matter; consequently, they died by the hundreds from malnutrition. Dead deer seemed to be everywhere. At the head of Stony creek, near the State Forestry Nursery, we found 6 within a distance of 200 yards. There were 79 found along this creek."

He continued: "It is obvious that to be successful, we must handle our deer problem with the same practical common sense that is used by the farmer in stock raising. This can be done only by the co-operation of the sportsmen with the Game Commission in killing off the surplus does from our overstocked ranges."

Many nationally-known naturalists became so much interested in the situation that they made special inquiry through correspondence

or went on record as favoring the Board's action. Among these were Carlos Avery, John B. Burnham, Dr. William H. Moore, T. Gilbert Pearson, William T. Hornaday, Seth E. Gordon, Maj. E. A. Goldman, Paul Redington, and others.

After the sportsmen of Pennsylvania realized that the Board were in earnest about putting the special season through, the opposition took definite form in several counties and injunction proceedings were brought about. First among these were those instigated in Pike and Monroe Counties by certain sportsmen backed by a clique of recreational park and hotel owners. These men succeeded in having injunctions granted but at the same time aroused antagonism among other sportsmen in their vicinity who did not want to hunt deer, and among the farmers who were suffering from deer damage. The opposition in Monroe County, particularly, claimed that while some deer damage occurred in that region it was not sufficient to warrant the special open season on does. This protest was at considerable variance with the petition presented by Monroe County landowners in 1926 requesting the Board to open their section to the killing of female deer to relieve damage to crops.

Following these came injunctions in Northampton, Wyoming, Cambria, Somerset, Clearfield, and Luzerne Counties. Upon counsel of attorneys for the Commonwealth, however, the injunctions in Cambria, Somerset, and Clearfield Counties were dissolved before the end of the hunting season.

Injunction proceedings caused protests from both sportsmen and landowners. In Cambria County, for instance, the two remaining hunting days after the dissolution of their injunction were not sufficient to permit the killing of many deer, particularly in the northern section, with the result that on January 1st, 1929, the Board was presented with a petition from 75 landowners in that area asking for immediate relief, citing the fact that many farmers were abandoning their property on account of the heavy deer damage.

Experience with court injunctions has shown the sportsmen and landowners the folly of such action and today practically every hunter and farmer is against them.

On November 26, 1928, the Board of Game Commissioners upon advice from the Attorney General stopped the issuance of further special deer licenses anywhere in the Commonwealth. This was done primarily to prevent the issuing of any further injunctions, since it was not certain at that time that a refund of license fees would be authorized should injunctions be granted and the Board wanted to preclude the possibility that hunters would lose both their right to hunt and the money expended for their licenses.

STATUS OF THE KILL

Many sportsmen feared that all female deer would be wiped out, that the illegal kill would equal that of the legal kill, and that the loss of human life would be tremendous. These fears proved to be imaginary; the results of the season were very gratifying.

During the season of 1928, 25,097 legal deer were taken, as against 14,374 in 1927. The illegal kill during 1928 was 1,593, of which 354 were fawn does weighing under fifty pounds. This is a ratio of one illegal to 16 legal deer, or 6%. During the preceding season, when only male deer could be legally taken, 1,186 deer were slaughtered illegally, a ratio of 1 illegal to 12 legal deer, or 8%. This, and the reports from our field officers citing the splendid cooperation they received, clearly shows that the hunters who went afield after big game this season were more law abiding than at any time in the history of the Commonwealth. Hunting accidents were not nearly so numerous as in 1927. During the deer season of 1928 only 3 men were killed and 20 wounded, as against 16 fatal and 24 non-fatal accidents during the preceding year.

CONCLUSIONS

Now that the 1928 special open season on antlerless deer has passed, and we have had opportunity to study carefully some of the results, we have come to the following conclusions:

First, that female deer are just as desirable as game animals as bucks. Many hunters who thought they could walk up to a doe as easily as they could approach a cow, went home without even having had a shot at a deer. After the first day or two of heavy shooting, the keen senses of the female animals asserted themselves to such an extent that thereafter very few does were killed. This proves that does are just as hard to bag as bucks.

Second, that hunting accidents were less frequent than in the 1927 deer season.

Third, that over-crowded conditions of the herd have resulted in the poor development of antlers among the young bucks.

Fourth, that the breeding period of deer is so upset as a result of the unbalanced condition of the sexes that many fawns are produced too late in the season for them to compete with their elders in securing food during the winter.

Fifth, that while deer observed in the fall appeared to be in a healthy condition because there was an abundance of food at that time, this fact has little bearing upon the food problems which develop, during severe winter weather, among young fawns.

Sixth, that while no serious disease has been noted thus far, this is no proof that a continuance of over-crowded conditions will not eventually induce such a disease.

Seventh, that the Game Commission will continue to curtail the planting of forest tree seedlings until they are certain these will not be consumed by deer which lack sufficient natural food during winter.

SPECIAL INVESTIGATIONS

Two special investigations of deer were made during the season (December 1 to 15) by the Bureau of Animal Industry of the Pennsylvania Department of Agriculture, and by the Bureau of Research and Information of the Board of Game Commissioners. In the course of the study, in which sportsmen throughout the Commonwealth cooperated, over 600 specimens of female genital organs were gathered and sent to the Laboratory of the Bureau of Animal Industry at Harrisburg. A detailed report upon these specimens will appear later. This report will include remarks upon pregnancy and upon indications of diseased condition such as might mean the development of chronic abortion or sterility. Such a final report may not appear for some months because detailed studies must be made. The complete field reports of the Bureau of Animal Industry and of the Bureau of Research and Information of the Board follow:

PENNSYLVANIA DEPARTMENT OF AGRICULTURE BUREAU OF ANIMAL INDUSTRY

DEER INVESTIGATIONS DURING THE 1928 SPECIAL DOE SEASON

By B. SCOTT FRITZ, V. M. D.

PURPOSE

At the request of the Board of Game Commissioners to the Bureau of Animal Industry, the writer was assigned to investigate and report a field study of the breeding situation of the deer in certain counties of Pennsylvania. He was also instructed to make observations for both external and internal parasite infestation, note any disease or pathological condition, examine and collect the reproductive organs from as many doe as possible and send them to the Pennsylvania Bureau of Animal Industry Laboratory for further study. It was requested that he report any other abnormalities observed that might influence the health of Deer.

ITINERARY

The investigation tour was started in company with Mr. James N. Morton, Assistant Chief of the Bureau of Refuges and Lands of the Board of Game Commissioners, on November 30, 1928. We arrived at the office of Mr. William F. McKinney, Forest Range Headquarters, Centre County, at about 7:30 A. M., December 1, 1928, where we were met by Division Supervisor John B. Ross and Dis-

trict Game Protector Thomas S. Mosier of the Board. Throughout the day we traveled by automobile and by foot in the sections of the county judged from rifle report to have a heavy kill of game. Examinations and notations of observations were made on the carcasses and reproductive organs of thirty-eight (38) female deer. Some of the camps visited were Shamokin, Selinsgrove, Ikesburg, Neff, Mainor, Benson, Millmont, Lakemont, Evergreen, Sassafras, Mohawk, Betz, Sun Set, and White Oak.

On December 2, we (Mr. Morton and Dr. Fritz) drove by automobile to Clearfield where we were met by District Game Protector William J. Davis of the Board and taken to the home of Mr. L. D. Rearick, Keeper of Game Refuge No. 2.

On December 3 and 4, 1928, Mr. Davis accompanied the writer in further studies and observations for that and the following day in Clearfield County. Practically all sections of the county were visited as well as a great many camps. The carcasses of a large number of doe were examined during these two days. We were unable to examine the reproductive organs, however, as the deer were eviscerated soon after the kill and the reproductive organs were removed with the viscera. In most instances the viscera were left in the woods which made it possible to view but a limited number.

On December 5, the writer was taken by Division Supervisor W. Claire Kelly of the Board throughout Elk County where studies were made surrounding the area of Game Refuge No. 34. A number of carcasses were observed, but the reproductive organs in most cases had been removed with the viscera. It appeared that the hunting season was nearing a close after the second day, because a decreasing number of hunters and killed game were observed.

On December 6, the writer was again met by Mr. Morton and was taken through other deer sections of the Commonwealth, most of the day being spent in Huntingdon County.

On December 7, sections of Huntingdon County not previously visited, and Mifflin County were visited with Mr. Morton and Game Refuge Keeper Ross G. Metz. This completed the investigation tour.

NATURE OF INVESTIGATIONS

After a somewhat exhaustive study of the literature relative to the physiology of reproduction in deer, little information was gained. Therefore, the character of information contained in this report is based on a comparative study of the anatomy of the organs of reproduction of deer with those in other animals. The same deductions are made from the investigation of deer as would logically be made from a study of a similar character in the cow, sheep or goat. Deer are comparable anatomically to the above animals with some variations in so far as observations of this character would determine. Com-

parative data was gathered on each carcass examined and the following notes were made in accordance with the following outline:

1. **Approximate Age.** It is reported generally that most of the fawn are born in the month of May with a varying number being born during the spring and early summer months. Carcasses of deer of this age were noted as immature, as indicated by hair coat, teeth development, texture and character of muscle fiber, bone and cartilage development. The reproductive organs, together with mammary and teat development of such carcasses, were typical of the young immature animal. Other carcasses examined were judged matured, by reason of similar observations, together with evidence of function in the reproductive organs. Carcasses of aged animals were likewise grouped for comparison. The latter group constituted what was judged to be nonbreeders, in that no recent functioning of the mammary gland was noted and the ovaries and uterus were thought to be inactive at the time of examination. Fat in large amounts was found deposited about the organs which would tend to indicate a state of inactivity.

2. **Condition of Carcass.** Notes made on condition of the carcass were based upon the amount of fat present and the absence of that which would be considered abnormal.

3. **Position and Characteristics of the Internal Organs.**

4. **Contents of Viscera.** Particular effort was made to determine on what the deer were feeding. The viscera were also examined for the presence of internal parasites.

5. **The Reproductive Organs.** The female deer were grouped for comparison as, (a) Those showing definite signs of pregnancy; (b) Those showing evidence of changes indicative of function in the reproductive organs; (c) Those not showing changes commonly associated with function. This group included the comparatively few immature females and the mature females thought to be non-breeders.

AGE OF DEER OBSERVED

Carcasses of 196 deer of ages from immature to the very old were examined. The youngest was thought to be four or five months of age and the oldest may have been fourteen to twenty years of age if judged exclusively by the appearance of the carcass. A rather high percentage, however, appeared to have passed the average age.

CONDITION OF THE CARCASSES EXAMINED

In view of the facts that we were dealing with wild animals, it is unnatural to suppose that their carcasses would be found to carry a degree of fatness that would naturally be found in the domesticated animal. The carcasses examined, however, indicated that the deer were in a satisfactory state of health. The abdominal cavity including the viscera contained a reasonable amount of fat and in some instances the kidneys and surrounding tissues could not be

observed, due to the over-abundance of fat in this region. This indicated that up to this time of the year the feed for the deer had been sufficient. None of the carcasses showed any evidence of disease and no evidence indicative of a previous disease was found.

POSITION AND CHARACTERISTICS OF THE INTERNAL ORGANS

It seems unnecessary to discuss this heading other than to say that for a comparative study the positions and characteristics of the internal organs are comparable to those of other ruminants. A slight difference was noted in the size of the stomachs, as compared with domesticated ruminants. This may be accounted for by domestication of ruminants which has brought about a change in these organs, while on the other hand, deer have remained in their normal state as browsing animals.

CONTENTS OF THE VISCERA

There were some variations in the materials found in the stomachs and intestines, but generally the contents of the stomachs indicated that the deer had been feeding on laurel, teaberry leaves and pine needles. The laurel seemed to predominate as a food. No evidence of any internal parasites was observed. This is a different picture than that presented by flocks of sheep, which are rarely found to be free from parasites.

The following charts I and II will assist the reader in following the classification of the carcasses examined:

CHART I CLASSIFICATION OF CARCASSES

Immatured
24

Matured
88

Aged
84

Chart I indicates a total of one hundred ninety-six (196) carcasses observed. Though it was possible to class them generally under the headings of "Immatured," "Matured," and "Aged," the chart is not particularly informative. The "Immatured" group is composed of deer born in the year 1928 which were thought to vary from four to nine months in age, based on the development of the carcass. The development was no doubt influenced by the season in which they were born and the food available, as well as the condition of the doe at the time of fawning. Those that showed evidence of having reproduced were classed in the "Matured" group. Some were apparently a year and a half to two years of age, while others would have been classed as aged had they not shown evidence of having recently produced fawn. Some of the doe judged to be ten to twelve years of age showed evidence of having suckled their fawn several months past. There were just three, however,

with evidence of milk in their udders, which would tend to indicate that they were suckling young or had just recently weaned them. Milk would not remain in the udder had the fawn been weaned for several months. The writer was told by a number of hunters that they observed doe with some very young fawn. We were fortunate in securing a very young fawn which had been injured but not killed. It was judged to be several months of age and it had undoubtedly been suckling. It was possibly born in October, which would not have given it time to reach the weaning age while succulent foods were available. It is doubtful if this fawn could have survived the winter.

The "Aged" group were classed as such for the reason that their carcasses showed evidence of age and that there was no indication of their having recently given birth to offspring. The reproductive organs of a great many of this class were heavily embedded in fat, which is indicative of a state of inactivity of these organs. This group was practically as large in number as that of the matured group. It would appear that this number is far in excess of that which one would expect, although we do not know the average breeding life of female deer. Over a twenty year period a high percent of non-producing individuals among our domesticated animals would be found if the aged animals were not regularly removed as soon as their cycles of reproduction had been completed. Some carcasses observed were termed very old deer. If their age could be definitely determined this would unquestionably reveal as a fact that these old deer are boarders which consume food needed by the younger reproducing deer.

ORGANS OF REPRODUCTION

The purpose of our investigation was primarily to assist the Board of Game Commissioners in establishing, if possible, the percent of reproducing doe in Pennsylvania's deer as compared with those not producing fawn. This necessitated the personal observation of the organs of reproduction, which includes the genital tract and its associated organs and parts together with the mammary glands and their appendages. In Chart No. II an attempt is made to classify the carcasses examined in a general way from the standpoint of reproduction.

CHART II

CLASSIFICATION OF CHANGES OBSERVED IN THE REPRODUCTIVE ORGANS

<i>Pregnant</i>	<i>Physiological Changes Observed</i>	<i>Inactive-Normal Appearance</i>
3	20	23

Forty-six (46) freshly killed carcasses with the organs of reproduction intact and suitable for examination were observed. A great many more specimens were collected and forwarded to the Laboratory of the Bureau of Animal Industry for a further examination.

Information gathered from members of the Game Commission, as well as others who have been associated with wild life, indicated that the period of estrum in deer is seasonable and that it is generally observed during the month of November. From a study of the organs collected, this information does not appear to be definite. The physiological changes which accompany estrum were found present in approximately fifty percent (50%) of the specimens examined. The physiological changes which occur in these organs of our domesticated animals during this period are quite definite in character. If this is true of doe, those fifty percent observed would indicate that some were approaching the period of estrum, others were in the height of it, while in comparatively few this period had been completed. In this connection our studies seem to indicate that organs of reproduction in deer function in a manner similar to those of some of the domesticated ruminants. The most unnatural aspect of this function has been undoubtedly brought about as a result of the elimination of the male deer (bucks). The length of the period of estrum in doe is not definitely known and if conception does not occur during one period it does not seem to be known whether estrum is repeated in several weeks to a month thereafter. In case that the estral periods are repeated, it is logical to suppose that there is a season of repeated estral periods for three to four months during the fall of the year.

In our travels a great many camps were visited and the following question was asked a large number of hunters, "Did you observe any evidence in the doe you killed to indicate that she was carrying offspring?" The reply in one hundred percent (100%) cases was, "No." Basing our decisions on a comparative study of other ruminants it would seem that few of the deer examined had been bred or else had not conceived.

Chart II indicates that three were definitely classed as bred; twenty were showing changes indicating that they were in estrum. They were in a receptive state and would most likely have conceived had they been bred. Twenty-three (23) revealed no evidence of function of the reproductive organs and were thought to be non-breeders.

Based on personal observations and reports, it would seem that doe were very plentiful and that there was a scarcity of bucks. Groups were observed with as many as twelve to fifteen doe and sometimes no bucks, or only one. The males in most instances were the young bucks known to the hunters as "spike" bucks and were judged to be nine to ten months of age.

It has been shown that there is a high ratio of females to males. Such being the case, it is highly probable that many of the fertile females do not have an opportunity to become bred, due to the limited number of males. This, together with the presence of a rather high percentage of non-breeding doe, would naturally reduce the number of

offspring to even a lower ratio. It is possible that male service is wasted on the so-called "barren or sterile doe." It is also possible that the older bucks are the best breeders and that many of the young spike bucks have not reached the age of sexual maturity.

In this connection there is another factor which may influence the estral period of doe. Men who have studied the breeding problems of sheep tell us that the presence of the buck has a tendency to induce estrum and make earlier breeding possible. In many respects deer are comparable to sheep and their reproductive organs seem to function in a similar manner. The male deer possibly undergoes a seasonal stage of sexual excitement known as rutting, and his association with doe during this season would have its influence.

HEALTH OF PENNSYLVANIA'S DEER HERD

The over-balanced ratio of sexes in the herd of Pennsylvania's deer cannot be looked upon as representing a healthy future of the herd. The natural tendency and purpose of all life is to reproduce itself. When an opportunity is not afforded for this function to be performed the state of health is affected. Doe that have had an opportunity to reproduce only one or possibly two sets of offspring have not completed their cycle of breeding. Inactivity in this respect tends to reduce the ability to reproduce and lessens susceptibility to conception by interference with natural functions. This would, therefore, show the necessity of a more even balancing of sexes.

The general feeding condition for the deer at the time of the investigation could be considered sparse. Conditions in the woods indicated that deer were already feeding upon those materials which are usually fed upon later in the year or after the natural browsing material has been eaten. The so-called "deer line" was observed in a number of localities and particularly in sections where the timber had attained considerable size and growth. The browsing material in these sections is reduced in proportion to the years of growth of the timber. The fact that the deer are forced to acquire food by ravishing farm crops is an indication that food material is not in abundance.

Based on the absence of disease in the carcasses examined, one may assume that the health status of the deer herd in general is good. It would be well to consider the prevention of the diseases commonly found among our domesticated animals likely to be conveyed to the deer which are forced to associate with our domesticated animals in procuring food. It has been reported that in some sections deer have frequently been seen grazing with cattle. Several years ago an infectious disease common to cattle was found among deer. Evidence obtained seemed to indicate that the deer had contracted this disease through association with steers recently purchased by a farmer and brought to his farm from a local stock yard. Association of this char-

acter affords an opportunity for the diseases common to domesticated livestock to be transmitted to the deer herd. Such diseases as Tuberculosis, Bang's Disease and others of an infectious character, if once established, would act as a serious menace and would be difficult to eradicate.

At the time of these investigations, the indicated shortage of food had not produced any ill effects, as the general health of the deer examined was good.

From observation one is led to believe that there are now more deer in Pennsylvania than are properly provided for by available feed. Therefore, a way to prevent the communication of disease to the deer herd would be to reduce the herd so as not to force them to seek food from our farm sections, or provide sufficient food material for them so as to prevent as much as possible their contact with domestic animals.

This year's procedure of permitting the hunting of doe, besides helping to correct the unbalanced condition of males in proportion to females, will temporarily reduce the size of the herd but should eventually cause an increase in size, although it will not alleviate the food shortage unless future seasons permit the killing of both males and females in sufficient numbers to keep the size of the herd reduced sufficiently, but in the ratio necessary to establish the proper proportion of one sex to the other and keep the breeding efficiency of the herd at its maximum.

In addition to keeping up a maximum breeding efficiency and maintaining health, there are many things relative to the breeding problems of game life which should be taken into consideration and thoroughly studied. This report deals with only a limited study and is intended to represent only a few observations which were made during one week in only one season of the year. No conclusive report can be given until after an extended study has been made. Such a study should extend over a number of years and should not be confined to only a part of one season. Any extended studies of this nature which are undertaken should of necessity be made by a qualified and capable veterinarian who possesses the fundamental knowledge on animal diseases. The program of a study of this nature having to do with animal diseases should be carried out by the Bureau of Animal Industry, Pennsylvania Department of Agriculture, in co-operation with the Board of Game Commissioners.

CONCLUSIONS

1. The Board of Game Commissioners is confronted with a problem relative to the deer situation that deserves further study.
2. The sportsmen should voluntarily desire an organized effort for such study.

3. There is an unbalanced condition of sexes in the deer herd.
4. The percent of doe not reproducing fawn is apparently high.
5. There has apparently been some change in the estral period of doe.
6. The unbalanced condition of sexes has been partially responsible for the change.
7. The present state of health in the deer herd is good, so far as communicable diseases concern them.
8. Barriers should be constructed to prevent the introduction of diseases of domestic animals.
9. Feeding material for the deer is becoming scarce and will be more so as the herd increases.
10. This year's doe season will tend to increase the size of the deer herd rather than reduce it.
11. Shooting of deer should not be confined to one sex after the proper sex balance is established, and is indicated only as one or the other sex becomes too plentiful.
12. The deer season should not come in the season of repeated estrum.
13. The older bucks should be preserved for a time for breeding.
14. The relation of age to sexual maturity should be studied.
15. The herd should not be permitted to become sufficiently large to cause a food shortage.

REMARKS OF LABORATORY SPECIMENS

Specimens of the genital tract of doe were forwarded to the laboratory, as previously mentioned in the body of the report. The laboratory has received approximately 650 specimens of this nature from various sources within this state. Their studies have not been completed, but so far as results are available, it is believed that the laboratory findings will in a general way confirm this report. Both the field studies as reported herein and those made in the laboratory seem to indicate that a low percentage of the doe examined were pregnant. It is understood that Dr. M. F. Barnes or one of his associates will render preliminary report of their findings in general, which will be followed later with a more detailed report.

DEER INVESTIGATION IN UNION AND SNYDER COUNTIES, PENNSYLVANIA, DURING 1928 SPECIAL SEASON ON ANTLERLESS DEER

BY GEORGE MIKSCH SUTTON

INTRODUCTION

On November 30, 1928, I went to Mifflinburg, Union County, to make a study of the deer in that section, with particular reference to animals killed during the special season. Headquarters were es-

tablished at the home of Game Protector Miles Reeder, who was with me during virtually all my field study. I remained in the region until December 8. Mr. Reeder and I were in the field every day, and we covered the best deer country thoroughly, visiting virtually every camp, and reaching some of the wildest portions of the region. Having an automobile, we were able to cover considerable territory daily, and we revisited certain camps in such a manner as to permit us to examine the fresh specimens as they were brought in. Our study has the merit at least of being thorough so far as this district is concerned. Much assistance was rendered by the sportsmen of the district who saved for us the female genital organs.

PURPOSE OF THE STUDY

The more we read what has been written about the White-tailed Deer, and the more we study the animal, the more clearly we realize how vague and unsatisfactory is our knowledge concerning the creature's life history. My purpose in making this study was to secure enough data to permit me to come to some honest, unbiased conclusions concerning the condition of our deer herd, to learn more about their food habits and problems, and to establish a basis for further study of their reproductive habits, their period of mating and gestation, and the normal time for the birth of fawns.

SPECIMENS EXAMINED

Due to the fact that we revisited some camps almost daily, we had some difficulty in keeping accurate account of the exact number of deer examined. At least 393 carcasses were inspected, some of them in the woods, just shot, but most of them, naturally, hanging up at farms or camps. The kill during the first four days of the season was relatively heavy and thereafter dwindled.

Most of the antlerless deer killed were does, and by far the larger portion in this section were large, well developed animals. Relatively few small animals were taken, and only one fawn weighing less than 50 pounds dressed was examined. Of the 393 animals studied, 96 were bucks, 13 of them illegal, that is, with visible antlers.

All deer examined appeared to be in excellent health. Most of them were very fat, some of them so fat as to make investigations of the viscera difficult. I noted no evidence of disease and no evidence that the animals had been suffering from lack of food or from any malady.

The stomachs were, **in every case**, well filled. In the majority of them was found a well digested mass of laurel, teaberry and other leaves, with which were numerous acorns, remnants of pine and hemlock leaves and particles of bark. In some stomachs were kernels of corn and partly digested blades of grass or winter wheat. Acorns

were evidently abundant, for all the stomachs held them. It appears that the acorn crop was unusually heavy this year in this section.

AGE OF SPECIMENS EXAMINED

There was much variation in age among the 393 carcasses examined. Relatively few were very young; most of them were adult. Young animals weighing between 55 and 70 pounds we thought to be from five to eight months old; other large sized, but obviously young animals, may have been born in the fairly early spring of 1928. Most of the does were fully adult, judging from weight, general appearance, condition of the hoofs and teats, and solidity of the bones. Their exact age was, of course, a matter of conjecture.

Some difficulty in recognizing this year's fawns was experienced. Many of the antlerless bucks examined were large in size, fully developed, and apparently over a year old. Their sexual organs, too, appeared to be those of adult animals; but the antlers either had actually not pushed through the skin, or were so small as to be hidden by the hair. Some hunters thought these individuals were less than a year old. Personally, I felt that they were well over a year old, and that they should have had larger antlers, even though these might normally have been tineless spikes.

It was evident to us that there were some very young animals in the woods, even though these were not often shot. Some does were still nursing fawns, which had been born, evidently, during the previous midsummer. I examined at least 22 does whose udders held milk and whose teats showed evidence of having been suckled recently. One hunter reported shooting a doe which had with it two tiny fawns, the coats of which were not yet entirely devoid of spots. The youngest animals I examined personally appeared to have been weaned, and certainly had lost their spots.

It was impossible to determine the age of the apparently old deer. The condition of some of these animals indicated a physical decline. One was somewhat splay-footed, and rundown in appearance. In others the sexual organs were so much imbedded in fat that these organs had probably been inactive for some time. There were so many of these adult animals which had apparently not been producing fawns that we were led to believe that a large number of the does taken had not had young during 1928. These animals were in good condition, to be sure, but they were not an active asset to the deer herd in that they probably consumed considerably more food than younger, smaller animals, without producing offspring.

REPRODUCTIVE ORGANS

I did not attempt to make any final examinations of the genital organs of the female deer because I felt that such examinations

would be crude and unreliable if made in the field, especially in view of the possibility that many of the wombs might only recently have been impregnated by the males. Four of the eighty-three specimens which I cursorily examined probably held small embryos, about the size of the end of my thumb, or smaller. One doe was reported with two embryos "the size of rats." All of the organs which I examined appeared to be in a healthy condition, and a large number of them showed signs of activity such as would accompany a normal breeding season. Others (about 30%) seemed to be completely inactive.

We have always supposed that dropping of the antlers indicated cessation of the breeding season. Basing our regulation of the season upon this assumption we have declared the regular deer season in early December, believing that by the end of November the breeding season is well over. Our 1928 investigation showed me either that we have been wrong in assuming that the breeding season is well over by December 1, or that there are now so many does that many of them simply are not served at all by the bucks. In other words, were the situation normal, we should expect to find, by the first week in December, a great percentage of the does with recognizable embryos, and all of them, perhaps even the older fawns born early in 1928, should show signs of sexual excitement of some sort.

The poorly developed antlers among numerous young bucks suggests the possibility that does have become so numerous as to make it unnecessary for the males to fight among themselves for supremacy. Natural enemies of deer have, of course, been eliminated. Antlers are first of all, probably, weapons for individual warfare among male deer; secondly, they are a means of protection against racial enemies. Many of the young bucks which I examined appeared to be sexually mature, yet they had such remarkably poor antlers that little fighting must have taken place among them during the fall of 1928.

ABNORMALITIES

A great deal of albinism was noted among the deer examined, especially in what is known as the White Deer district, near Mifflinburg. One almost pure white antlerless buck was seen; a large, white, four-point buck was killed at Herman's Camp. Many does and bucks in this district displayed albinistic tendencies, particularly in the coloration of the legs and feet. The presence of albinism may not indicate any radically wrong condition, but it appears often to accompany an over-crowded state of affairs. Albinistic deer are, of course, freaks. They would normally fall prey to their natural enemies more readily than normally colored animals, because a white deer is not protectively colored. In Pennsylvania, however, where the deer have no natural enemies, albinistic strains may continue for a long time.

A doe with antlers was examined in Snyder County; her genital organs appeared to be inactive. An animal with warts was examined. Cases of this sort might occur, of course, in any race of wild animals. But their presence here means the continuance of their strain, in view of the absence of natural enemies which would normally weed them out. Herein lies danger for the Pennsylvania deer herd.

PRESENT CONDITION OF THE DEER HERD

It appears that our deer herd is, in a sense, assuming the same dependence upon us for proper management as does a herd of live stock. With the universal urge to reproduce their kind, deer have continued to breed and to bring forth fawns quite unaware that because of our continued protection of the females since 1907 they have gradually been losing some of their outstanding racial characteristics. Antler development appears to be dwindling because there is not need of defense against enemies nor of contest among bucks for supremacy over the females. Breeding is so promiscuous that fawns may, apparently, be produced at almost any season of the year. This means that when food problems are severe in winter, fawns born late in summer are destined to have a difficult time competing with their elders in finding food during the worst part of the cold season.

The healthy bodies of animals examined in Union and Snyder Counties indicated to me that during the fall of 1928 in this section at least there certainly was no serious lack of deer food—quite the contrary, in fact. But this does not mean that there will be no food problems during the coming winter.

It appears to me that the Board of Game Commissioners have adopted a wise course in permitting the killing of does during the past season. Pursuit of these female animals will not only do them individual good in reviving the instinct for self-preservation which has been relatively dormant for so long, but it will eventually mean a strengthening of the race, the production of better game animals, and the eventual elimination of animals which should not reproduce their kind.

There is in all Nature a tremendous tendency toward over-production. When natural enemies are removed, and when environmental conditions approximate the ideal, a herd of big game animals may reach enormous proportions within an amazingly short time. When Man has nothing to do with such situation Nature usually restores a proper balance through an invasion of predators which promptly destroy the surplus animals, or through a period of famine or disease which weeds out surplus animals to such an extent that the remaining individuals have enough to eat and to spare.

Pennsylvania sportsmen, it appears, are taking into their own hands the control of their deer herd. They do not want predatory animals

to abound, nor do they want a famine or pestilence. They have therefore decided to eliminate a portion of the deer herd in a relatively drastic manner. This action ought to help to remedy the over-crowded conditions which exist among the deer herd in many parts of the State.

The Board has just received the following word from the Laboratory of the Bureau of Animal Industry as to the progress of their work in examining the female deer organs turned over to them :

Department of Agriculture
Laboratory, Bureau of Animal Industry
Harrisburg, Pa.

January 11, 1929

Dr. George M. Sutton,
Game Commission,
Harrisburg, Penna.
Dear Dr. Sutton :

This letter embodies a preliminary report on the examination of the sexual organs of female deer submitted by members of the Game Commission and Dr. B. S. Fritz to the Laboratory of the Penna. Bureau of Animal Industry during December 1928.

Approximately 650 specimens of this nature were received. Of this number two showed macroscopic uterine pregnancy. It has not been possible to carry on complete examinations but further work is in progress in which microscopic studies of ovaries and uterine wall are being made.

No macroscopic evidence of disease was present in any of the specimens. Inoculation experiments are in progress, however, to further eliminate this factor.

A complete report of our findings can not be made for some time but will be forthcoming as soon as possible.

Very truly yours,

Signed : M. F. Barnes, *Director*

*Compiled by The Bureau
of Research and Information of
The Pennsylvania Board of Game
Commissioners.*

Harrisburg, Pa.,
January 18, 1929.

PART 2

INTRODUCTION

The field and laboratory studies which preceded the issuance of *Bulletin No. 12*, after the open season on antlerless deer in the fall of 1928, have been continued with the utmost thoroughness, and the purpose of this supplement to that bulletin is to present to the sportsmen of the state, and to the citizens of Pennsylvania in General, the findings from these continued studies and to report the present status of the Pennsylvania deer problem.



RED PINE BROWSED AS HIGH AS A LARGE DEER
CAN REACH STANDING ON ITS HIND FEET.

THE FOOD SITUATION

The deer food situation, instead of improving, grows continually more serious, and was especially critical during the winter of 1929 and 1930, as the acorn and beechnut crops were a complete failure throughout the state except in a few areas of very limited extent. Had not the winter been mild, with unusually light snowfall except

in a few localities, and with almost no crusting, the loss of deer by starvation would undoubtedly have been appalling.

And as many species of deer food, especially laurel and rhododendron, sumac, the Hercules' Club (a great favorite with deer, in spite of its prickles), and mountain ash, soon die, root and branch, from over-browsing, the food situation is becoming increasingly acute from year to year.

In the parts of the state having a large deer population an alarming percentage of the sumac, mountain ash and Hercules' Club has already been destroyed, both by over-browsing and by "barking,"—and a large percentage of laurel and rhododendron has also been killed.

We have reached the point—in fact passed it—where the problem is not how to produce an abundance of deer for our sportsmen and lovers of the wild, but how to feed those we already have. If a farmer's feeding possibilities for his domestic cattle were definitely limited, he would certainly have more intelligence and common sense than to continue trying to carry twice the number for which he could possibly find food. But that is exactly the problem set for us in Pennsylvania by the ratio between the numbers of our deer and the amount of food available to sustain them.

Investigations in Pike, Clearfield and other counties, not only by Game Protectors of these counties and officers from the Harrisburg office of the Game Commission, but also by various disinterested scientists from outside the state, have shown an appalling scarcity of food for the large numbers of deer now on the ground. In certain parts of Pike County, for instance, not only was every particle of edible undergrowth eaten out,—even laurel and rhododendron utterly killed over large areas—but even the terminal twigs of the rock or scrub oak were eaten off to one or two inches beyond the bud for as high as a deer standing on his hindlegs could reach.

And the condition is little better in other areas of considerable extent.

Furthermore, this almost complete destruction of the undergrowth not only assures just that much less possibility of carrying even the present number of deer through coming winters, but also destroys the cover for small game, especially ruffed grouse and woodcock and rabbits, and causes either their death or their migration to other localities. It is not only the deer hunter that must face this question of over-browsing, but the small game hunter as well.

The following reports, from firsthand observations, by Dr. B. Scott Fritz, of the Pennsylvania Bureau of Animal Industry, and Vernon Bailey, Chief Field Naturalist of the U. S. Biological Survey, and probably the foremost field naturalist in the world today, speak for themselves.

INVESTIGATION OF DEER LOSSES

By B. SCOTT FRITZ, V.M.D.,

*Pennsylvania Dept. of Agriculture
Bureau of Animal Industry*

INTRODUCTION

The following report is submitted in lieu of a request from the Game Commission that the Pennsylvania Bureau of Animal Industry investigate the cause of deer dying in the area of Game Refuge No. 2, Clearfield County, Pennsylvania. The investigation was made by Mr. Vernon Bailey, representing the Federal Biological Survey Division; Messrs. Luttringer, Kelley, Davis, Hassinger, Logue, and Rearick, representing the Game Commission, and the writer representing the Bureau of Animal Industry.

ITINERARY

March 13, 1929, with Messrs. Bailey and Luttringer, we went to Clearfield, Pa., and were met by Game Protectors Kelley and Davis and taken to the home of Mr. Lawrence Rearick, Keeper of Game Refuge No. 2. Mr. Rearick's home was our headquarters during the period of the investigation. March 14th and 15th we traveled by automobile and on foot around the Refuge, about the State Forestry Nursery and throughout the area surrounding Crystal Springs Camp. Having then completed our investigation, we started for Harrisburg the evening of March 15th and arrived about 2 A. M. the morning of the 16th. Weather conditions were unfavorable for an extended investigation, as traveling conditions were becoming impassable by automobile, due to the thawing out of the roads. However, during the two days we covered a lot of country and believed that we had a general knowledge of existing conditions.

FOODS BROWSED

The report in this connection is brief to eliminate a duplication of findings. Mr. Bailey, a naturalist of repute, will unquestionably report specifically the conditions in the woods, with special reference to the browse. Food was sparse in all sections visited. The so-called "deer-line" was observed, indicating that food has been obtained with difficulty. When a "deer-line" is produced, one may expect to observe unusual results; such as deer dying from starvation and other causes that would not ordinarily produce death, together with a vast amount of damage to forest trees and seedlings. Many trees were completely barked from the ground up to as high as the deer could reach.

The sections we visited appeared to be so much over-browsed that they may be killed out. An investigation during the summer would determine how extensive the damage has been and thereby informa-

tion could be acquired that would be helpful in formulating plans for the future. Little or no low growth has been left standing and many of the trees are so badly barked that hundreds will most likely die. Mr. Bailey informed me that ten (10) or even twenty (20) years may be required to bring this section back to its former state of growth. If such is the case, conditions can not be immediately corrected, and relief will be brought about only by reducing the number of deer or supplying them with food. The latter seems impracticable as an immediate relief.

The following trees and shrubs show evidence of having been heavily browsed: Oak, Cherry, Maple, Ash, Hemlock, Spruce, Pine, Sweet Fern, Blueberry, Hazel, and Laurel. The Laurel appears to be the least browsed, most likely due to its abundance and the fact that it is a food which the deer eat only when there is a scarcity of the other more desired foods.

It was apparent in the particular sections where deer were found dead, that the Laurel had been more heavily browsed; in fact, it was impossible to find any with the tops not eaten. This was noticeable in the low swampy lands. Here the Laurel appeared greener and the tops more succulent.

Our observations were confined to a comparatively limited area of the county, but the apparent scarcity of food for the older deer was marked evidence that the proper nourishing food for younger deer was not available.

A group were observed browsing and particular note was made of the older deer in this group eating as though they had ravishing appetites. Several younger deer in the group were having difficulty in procuring food at all, as the older deer seemed to resent their presence and were constantly chasing them off. Several times one of the older deer would strike out at the younger ones. This may explain to some extent how difficult it has been for the younger deer to procure food, and most likely why the deaths occur in the fawn group.

POST-MORTEM EXAMINATION

The carcasses of seventeen (17) deer were found. Several of the deer were observed in a recumbent position as though they had died under the influence of a powerful narcotic or as if they had slept away. No lacerations, contusions, or abrasions were observed by examination of the haircoat and skin. No discharges or unnatural conditions were noted of the normal body openings. The deer had been dead for some time as identified by post-mortem decomposition. Lice were found present on all carcasses examined. The mouths of some were found filled with food. This was thought to indicate that they had died in a condition of stupor or that death had followed soon after the regurgitation of food. A condition of this kind could be

induced by death from the action of an emetic or if the animal had died in a convulsive attack. The food in the mouth had in some instances been thoroughly masticated, while in others it had been browsed but a short time before death. The animal was apparently overtaken by death before masticating. The lice found on the deer have been identified as *Trichodectes tibialis*, a biting species. No importance is placed on their presence.

AUTOPSY FINDINGS

A complete autopsy was not made on all carcasses, due to post-mortem decomposition. The carcasses completely, as well as those partially autopsied, were observed to be in a very emaciated condition. Not even the slightest amount of fat was noted about the internal organs or viscera.

In carrying out the autopsy the deer were weighed. The weights varied from twenty-one (21) to fifty (50) pounds, or an average of forty (40) and some fraction of pounds. Ten (10) were Bucks and seven (7) were Does; all judged to be last spring's fawns, and not more than eight (8) to ten (10) months of age. The greater number were most likely born late in the season and, therefore, late weaned.

Autopsy findings revealed no evidence of an infectious or contagious disease.

Several of the carcasses showed evidence of the presence of an irritant in the stomach and small intestines, resembling that which would be found following the ingestion of a toxic plant. In the course of autopsy on these cases, it was noted that the mucous membranes of the four stomachs stripped with ease, which may have been partially due to decomposition. Beneath the mucous membranes, however, were small hemorrhages varying from the size of a pin point to rather suffuse striations, indicative of a poison. The stomach content was not lacking in quantity, but was thought to have little nutritive value. It varied in weight from three (3) to nine (9) pounds.

The deer has four stomachs, or rather, one true stomach and three (3) so-called stomachs which are diverticuli of the oesophagus. Little digestion takes place in the first three (3) stomachs. They are store houses or reservoirs for the food, where it receives digestive juices and a thorough mixing. Food is regurgitated for further mastication from the first of these stomachs. The first stomach contained foods of a varying character, such as small twigs, bark, hemlock, pine, etc., and a rather high percentage of Laurel. Mr. Bailey judged the stomach contents, in most cases, to be seventy-five per cent (75%) or more of Laurel. These materials as foods have little nutritive value. Laurel should not be considered as a natural food for deer, as they eat it only when other foods are not available. The contents of the stomachs were observed to be in various stages of digestion.

The internal organs, mucous membranes, thoracic and abdominal cavities, viscera, etc., presented nothing for particular note.

SUMMARY

Those who are familiar with the normal weight of a deer carcass, eight to ten months of age, will appreciate the state of emaciation of the deer we observed by the weights reported. This does not picture the true state of emaciation, yet, in view of these facts, it is questionable if death occurred exclusively from starvation. More significance should be placed on the fact that the deer are consuming large amounts of Laurel.

Two species of *Kalmia* are known to be poisonous. *Kalmia latifolia* (Laurel Ivy) and *Kalmia angustifolia* (Sheep Laurel).

Sheep that die from eating the former, show symptoms of difficult swallowing and become stiff before death. Laurel Ivy is thought to render the flesh poisonous, giving rise to trembling sickness.

Kalmia angustifolia is called the sheep laurel because it is poisonous to sheep. It is credited with causing wart irritation of the skin which may extend over the body and legs. Two of the deer observed showed evidence of a skin irritant, about the legs and abdomen. Sheep laurel causes dullness and stupidity with vomiting, etc. It is reported that sheep go into deep lethargy before death.

Laurel contains a toxin known as "Andromedotoxin." It is a narcotic, an emetic, has other poisonous properties, and it is known that comparatively small amounts kill livestock. Is it not possible that this toxin would also kill deer provided they consumed sufficient amounts when in an under-nourished state and more susceptible to a toxin of a poisonous plant?

Older deer have a greater variation of foods. Then, too, they may establish a tolerance against Laurel poisoning which would make it possible for them to consume larger amounts. As previously stated, the deer found were young. They had been born late and weaned in a season when succulent foods were not available. Being born out of season, and forced to consume foods which is not the type of food they should have had as young growing animals, their digestive system has been weakened, their state of vitality lowered, and they would more readily succumb to the influence of a strong toxin. The fact that the poisonous property of Laurel is a narcotic may explain why we found some of them in a position indicating that they had died as though under the influence of a narcotic. It being an emetic may account for the presence of food in the mouth.

CONCLUSION

It appears that the deer have died as a result of several causes. The predominant ones being the consumption of large quantities of Laurel

together with their state of emaciation. Emaciation has been brought about by a scarcity of food due to the fact that the country is heavily populated with deer. The snowfall has been more than normal in this area, which has limited their browsing, and reduced the available food. Had the deer which have died been born earlier in the season, they would have been further matured, more able to procure succulent foods over a longer period of time, and thereby better withstood winter conditions.

It is well to know that death is not being caused from a disease condition. It would be worthy to consider reducing the deer herd in this section, as it does not seem humane to permit deer to be born in the spring months only to be starved out and possibly poisoned by food they are forced to ingest during the winter months.

If conditions are not regulated to create better feeding for the deer herd, nature will do her own regulating. It does not seem practical to offer as a suggestion the feeding of game life during certain months of the year. Our investigations have been made in a spirit of cooperation. If the cause of death has not been determined, the investigation at least is helpful in compiling additional information. Further studies and investigations should be made.

The following report was submitted by Dr. James W. Kellogg, Director-Chief Chemist, Bureau of Foods and Chemistry, as their findings on the stomach contents of deer submitted for analysis:

“There was found in the stomach contents laurel leaves, laurel stems from leaf and hemlock twigs. It was also noted that the tissues of the stomach were disintegrated in spots and easily torn. After drying the contents resembled soil humus and laurel leaves and hemlock twigs were easily noted and detected. We have been unable to find any method for determining the poison Andromedo Toxin which is the poison found in the Genus *Kalmia*. Reference as to the action of this poison can be found in the U. S. Dispensatory, page 1201.”

DEER INVESTIGATIONS IN PENNSYLVANIA

March 13-15, 1929

Vernon Bailey

Under instructions from the Chief of the Biological Survey, I went to Harrisburg on the evening of March 12th and the next morning after a conference with Mr. John J. Slautterback, Executive Secretary of the Game Commission of Pennsylvania, started for Clearfield County where the deer had been reported dying in considerable numbers. Was accompanied by Leo Luttringer of the Game Commission and Dr. Fritz of the State Bureau of Animal Industry. With a big Studebaker six we drove about 200 miles from Harrisburg to Clear-

field and then seven miles northwest to Game Refuge No. 2 on top of the high plateau of the State Forest and State Game Lands.

At Clearfield we were joined by Division Supervisor Kelly, and Protectors Davis, Logue and Hassinger, and we all arrived at the Refuge about 5 P. M., and stayed with the Refuge Keeper, Rearick, where I worked last spring. The valley country along the way from Harrisburg to Clearfield is all open and bare ground with little green vegetation and no flowers. There is a trace of snow on high ridges and some cold slopes. Beyond Clearfield all but south slopes were covered with snow a few inches to a foot deep and the roads were frozen so as to be fairly solid and passable.

The weather was warm and pleasant until we reached the snow country at Clearfield at 4 P. M., when a light rain and fog began and continued the rest of the evening, all night, and most of the next day. The fog was merely local over the snow from the chilling of warm, moist air and all during our two days and nights at the refuge the snow and ice melted rapidly.

On March 13 and 14 we covered a lot of country with cars and on foot around the game refuge and the State forestry nursery and about Crystal Springs near there, examining dead deer and the food conditions. During our stay much of the snow melted and the water ran in streams in the roads so by the night of March 14th the roads were softened until we could not use the heavy car and had to leave it and return with a light car to Clearfield and then home by train.

Arrived in Washington at 8 A.M., March 15th.

During the two days, March 13 and 14, we examined 17 dead deer, all fawns of last spring and about 9 months old when they died. Each was weighed and recorded for sex, weight, bodily condition, and food contents of stomach. One was measured and skinned for a specimen and photograph after skinning to show emaciated condition.

All were very poor, with shrunken muscles, projecting hip-bones, backs and bare ribs. In weight they varied from 32 to 50 pounds, or an average of about 40 pounds. The stomach contents weighed from 4 to 9 pounds, and the stomachs empty, when washed, weighed about one pound each.

The stomachs contained about the normal quantity of food found in such animals, varying from half full to well filled. In some cases the food was well masticated, approximately all having been well ruminated and finely pulverized, and in other cases largely coarse and not masticated for the second time. In both cases much of the contents could be recognized as to plants eaten and a very general estimate was made of the quantity of each of the main food plants. Of course, no accurate percentage could be given.

The conspicuous foods recognized in the stomachs were mountain laurel (*Kalmia latifolia*), the evergreen leaves, buds and tips of leafy twigs. Many of the leaves and buds were entire and perfectly recognizable and even the well-chewed mass could be told by a bright green appearance unlike any other foods. In many cases laurel averaged half or more than half of the stomach contents and in one case it was given an estimate of 8 pounds in a very full stomach containing about 9 pounds of food. In one stomach no trace of laurel could be found. Laurel is abundant, low, and leafy with soft tender leaves and twigs that probably do not hurt the delicate teeth of fawns.

The leaves and young twigs of hemlocks, spruce, Norway pine, and white pine are considerably eaten where they are within reach, but most of these evergreens have been trimmed to a "deer-line" above the reach of the fawns, usually to about six feet from the ground. In a hemlock swamp on the head of Stony Creek we found seven dead fawns, five of which showed considerable hemlock leaves in the stomach contents and the young hemlocks had been heavily browsed. There is no native spruce but most of the planted spruces have been eaten by the deer.

Sassafras is a favorite browse with deer as with rabbits, porcupines, beavers and a great variety of animals, but is being killed over extensive areas where once abundant. It is tender and pleasant tasting and probably a good food if enough could be obtained, but after the twigs are nipped off one year and again the next year the side branches cease to grow and hundreds of dead bushes are seen still standing. Fortunately there are a lot of fair-sized sassafras trees whose berries scatter and start new plants so it keeps coming on as future food and is not easily exterminated.

Sweet fern (*Myrica asplenifolia*) is abundant on certain dry slopes and ridges and is much browsed by the deer. Its brown, fuzzy twigs are easily recognized in the stomach contents and are found in most of those from the vicinity of Crystal Springs where it is abundant. It would seem to have little food value.

Blueberry bushes, several species of *Vaccinium*, are much browsed and the fine red twigs are conspicuous in many of the deer stomachs. During deep snows they are not available but are now uncovered and much eaten. Other browse and deer food consists of the buds and twigs of sassafras, witch hazel, chestnut sprouts, oak of three species, pin cherry, black cherry, soft maple, sugar maple, beech, ironwood, and a great variety of forest trees and shrubs. A few mountain ash trees were found and most of these were peeled, and the bark eaten from the base as high up as the deer could reach, the upward scraping of the lower incisors showing plainly on the naked

trunks. In like manner hundreds of staghorn sumac bushes, one to three inches in diameter, had been peeled and the bark eaten from the ground to five or six feet high, as high as the big deer could reach, but generally with large incisor marks of old deer and we found no recognizable bark in the stomachs of the fawns. This bark is thick and pulpy and good food, but unfortunately the sumac with their loads of berries, which the grouse like, are being killed out over the deer country. On the slope beyond Crystal Springs there were hundreds of these bare white trunks peeled by the deer and a few peeled near the bottom or higher up than the deer could reach, by porcupines, the cross marks of the double set of incisors showing their work, while the deer teeth have left only broad up and down marks. Rabbits and squirrels also eat the bark of the staghorn sumac and I find it very pleasant tasting.

These are only a few brief notes on deer food as observed on this trip, but given as a contribution toward the full study of deer food that should be made.

The cause of death in the deer examined is not fully determined by our brief study but we were fortunate in having an able veterinarian with us in Dr. Fritz of the Pennsylvania Bureau of Animal Industry who made careful examinations of the stomachs, livers, hearts, lungs and other internal organs, as well as the mouths, nasal passages, trachea, esophagus and general bodily condition.

In the field his opinion frankly expressed was that there was no indication of any disease among the deer other than malnutrition, and unless he finds additional evidence from specimens collected or sent in to the laboratory or finds evidence of sufficient toxicity in the laurel leaves to account for the death of the fawns there will be no better explanation than that they starved to death.

It may seem strange that deer with full stomachs should starve, but if the food eaten contains little or no nutriment they may well grow weaker and weaker until the bodily condition in which they are found. Some were so weak that the game protectors ran and caught them and brought them in alive. The next step is to lie down and be too weak to get up again or to withstand a cold night. To me it seems conclusively evident that the fawns have died because the larger deer have eaten practically all the nutritious food to a height above their reach. They have died only on the most congested parts of the range where the deer population is still greater than the carrying capacity of native food.

We were not looking for live deer but while hunting the dead deer we saw six deer one day and 17 the next and great numbers of tracks; showing a dense deer population. Many of the feeding slopes and winter deer yards are covered with deer signs and tracks and trails,

like a bed ground for domestic sheep. It is apparently only in the overstocked part of the range that there has been any loss of fawns.

**Stomach Contents of 17 Dead Fawns, 8 or 9 Months Old.
Clearfield County, Pennsylvania, March 13 & 14, 1929.
Vernon Bailey.**

Sex & Weight Lbs.	Stomach Contents Lbs.	Laurel	Pine Hemlock Spruce	Sweet Fern	Blue-berry	Other Browse	Remarks
On the refuge							
M 50	5	2-½	1-¼	-----	-----	1-¼	A few lice; V. P.
M 35	4	3	¼	-----	-----	¾	Very lousy; V. P.
F 34	4	1	1	-----	1	1	A few lice; V. P.
F 21	9	8	½	-----	½	-----	A few lice; V. P.
Head of Stony Creek							
M 44	6	3	2	-----	-----	1	Very lousy; V. P.
F 42	5	-----	-----	-----	-----	5	A few lice; V. P.
M 40	-----	-----	-----	-----	-----	-----	A few lice; V. P.
M 43	5	2	2	-----	-----	1	A few lice; V. P.
M 35	4	2	-----	-----	-----	2	A few lice; V. P.
F 36	4	3	½	-----	-----	½	A few lice; V. P.
F 44	4	2	-----	-----	-----	2	A few lice; V. P.
M 47	9	4	2	1	1	1	A few lice; V. P.
Near Crystal Springs							
M 36	4	1-½	1-½	1	-----	-----	A few lice; V. P.
M 37	4	3	-----	-----	-----	1	A few lice; V. P.
M 45	6	3	-----	2	-----	1	A few lice; V. P.
F 35	4	2	-----	1	-----	1	A few lice; V. P.
F 40	5	2	-----	1	-----	2	A few lice; V. P.

DEER IN PENNSYLVANIA

November 6-9, 1929

BY VERNON BAILEY

On November 6 Doctor W. B. Bell and I left Harrisburg, Pa., at 11:15 A. M., with Messrs. John J. Slautterback and Dr. Winecoff of the Pennsylvania Board of Game Commissioners, and Doctor C. D. Marsh of the Bureau of Animal Industry of this Department, to look over the present deer situation.

We stopped at Pennsylvania State College to consult with Dr. Forbes and his staff on poison food tests being carried on by feeding healthy deer on laurel and rhododendron leaves and twigs. We then proceeded to Clearfield and seven miles beyond to Game Refuge No. 2 for the night. This is up in the mountains at 2,300 feet altitude in the most congested deer population of the State and where there was the heaviest loss of starved fawns last spring.

On November 7 we drove around by Medix Run and to Game Refuge No. 34 on the head waters of Mosquito Creek and tramped over the refuge and surrounding country for a part of the day, returning at night to our old stand at Refuge No. 2, covering 55 miles by auto.

On this trip we counted 107 deer, only two of which had visible horns. They were largely does accompanied by twin fawns, all apparently in good condition. Great numbers of hunting camps, mostly on State forest lands, were seen and preparations are being made for the opening of the deer hunting season on December 2. Only bucks are to be hunted this year and a kill of 20,000 in the State is expected.

On November 8 we visited the State forestry nursery, all under fence, and the head waters of Rocky Creek, where there was heavy mortality of fawns last spring. We then proceeded to Game Refuge No. 1 in Clinton County, and talked over conditions with Mr. W. F. Mason, the Refuge Keeper, then on to Lock Haven for the night. Saw only a few deer, about seven in all, but three of them with horns and one good set of horns. Saw many ruffed grouse along the roads, singly or in small bunches up to four in number. They are increasing very satisfactorily under complete protection and vigorous destruction of their enemies, goshawks, owls and carnivores.

On November 9 we drove to Mifflinburg in Union County, saw Miles Reeder, Game Protector, and then on to Refuge No. 6, on Penn's Creek, where we were joined by J. B. Ross and went over the refuge with him and the Refuge Keeper, Harry Wingard, and saw where they were feeding corn to wild turkeys, squirrels, bear, deer and raccoons. Stopped at Woodward Cave on our return and got four species of bats on the walls and then back to Harrisburg, where we were too late to catch a train home and had to stay over night at the Penn-Harris Hotel. Saw a few deer and plenty of deer signs, but the country is not overstocked. Saw many ruffed grouse and signs of wild turkeys. No acorns or nuts or berries and the winter is going to be hard for deer and bear and squirrels and grouse. Much feeding will be necessary to prevent heavy losses.

FORAGE CONDITIONS

There has been little rain during the past growing season and plant growth is very slight. There are practically no acorns or beech nuts or other nuts, no berries, such as mountain ash, black haw, elderberry, wintergreen, eat briar, sourgum, or other native fruit, except a few poorly developed bunches of staghorn sumae. The recovery on over-browsed shrubs of last winter has been slight and all plant growth meager. As a result forage suitable for deer is scarce and the deer are already beginning on their winter browse. The deer are in good condition now but the range is heavily stocked and if a hard winter of deep snows follows there will be a heavy loss of deer, largely fawns, by next spring. If a mild and open winter favors the deer they probably will scatter out over wider range and pull through with no great losses, but the fact remains that much of the range is badly overstocked and that a heavy reduction of does should be encouraged next year.

The benefits from killing does last year, or rather from sparing the bucks, is now seen in the great number of twin fawns seen with the does but this only complicates the dangerous situation by more heavily overstocking the range. There seems to be now approximately a good balance of sexes and it is unfortunate that any further discrimination in sexes killed should be made. Probably, however, an alternation of bucks one year and does the next will eventually give a fair proportion of sexes. It still seems, however, that the best balance of the deer herd could be maintained by removing all restrictions as to sex or age, and if any hunters are satisfied with does or fawns during the overabundance of deer they would be helping to balance the herd as well as improving the quality by leaving more of the fully mature deer to breed.

The present system of killing the best and leaving the inferior to breed is bound to be fatal to the herd in course of time.

RANGE IMPROVEMENT

During the summer large numbers of blight resistant Japanese chestnut and chinquapins have been introduced for planting on the deer range to take the place of the common chestnuts which are practically all dead or dying. Other nut bearing shrubs and trees should be brought in and well distributed over the deer range to improve and increase its future carrying capacity. Also clovers, vetches, alfalfa, grains and buckwheat could be grown in scattered small fields or patches on the State game or forest lands to carry the deer through the summer, fall and spring, and save the more important browse for winter use. The eagerness with which the deer now seek the little patches of white clover clinging to old camp or farm sites shows how fully they would utilize such food. It could also be used to hold the deer in desirable locations.

At present there is great abundance of the two species of native aspen, quaking aspen, and the large toothed, both of which are favorite winter food of the deer. In this region the trees have been browsed as high as the tall deer can reach the branches and no seedlings are allowed to grow up to furnish browse. Great numbers of the aspens have reached maturity and are dying of old age and heart decay and thousands die every year. They are at best a worthless part of the forest without sufficient value for even wood or charcoal to pay for their removal and there are no factories for the excellent wood wool which their trunks would afford. Enough of these trees could easily be slashed during the deep snow period to feed all of the deer until the snows melt in the spring and release the other food. Cutting these trees not only feeds the deer, but makes room for other growth and would also result in great numbers of quick growing sprouts from the stumps or roots of the aspens and the production of a most desirable browse of young aspens.

CONCLUSIONS

The present deer herd should be considerably reduced over much of its range. The deer range should be greatly improved and varied. Its carrying capacity can and should be doubled but this will be very difficult with the over-crowded range. The present tendency is toward depletion instead of improvement.

Nut and grain foods are especially desirable so the deer will enter the winter season in prime condition.

Bigger and better deer for breeding should be more important than big deer for the hunter.

OFFICE OF THE
BOARD OF GAME COMMISSIONERS
Harrisburg, Pa.

REPORT OF DEER INVESTIGATION DURING DEER SEASON OF 1929

BY DR. B. SCOTT FRITZ *of the Bureau of Animal Industry*

Mr. Morton and I had a very interesting and instructive trip during the first week of the large game season. More information was obtained from our observation than inspection of killed game. The limited amount of illegal killed game that we observed in the counties of Union, Mifflin, Clearfield, Elk and Centre, would indicate that the illegal kill will be unusually small throughout the State for the season. The weather was cold and disagreeable, which made hunting difficult. This may account for the limited kill.

We made particular note of the fine specimens of buck deer that were killed. A large percentage of them had well formed antlers and were of the four-point class. The deer observed were in a fine condition of fitness and each one examined displayed a fair amount of fat about their internal organs. This is a true indication that they had fed well during the summer and fall months. The deer appeared in better condition this year than those observed last season. The buck, however, may carry a higher degree of fitness than the doe. This is the first opportunity we have had to examine carcasses of male deer, and a question of fitness would be determined only after several years' observation. It is natural to suppose that deer would be found in good condition this season of the year, and rather pleasing to know that such was the case. Notes are comparative of previous examinations.

Though the deer were in good condition then, the scarcity of food will undoubtedly make them less fit by spring. Throughout the sections visited, it was noted the deer were already feeding on those foods which ordinarily they do not feed upon unless there is a scarcity of the foods which are their first choice.

The information gathered from men with whom we discussed the present deer condition, and our observations, indicate that the range conditions have not been greatly improved by the past year's doe season. During the three days spent in Clearfield County, doe were seen in groups of three to ten and twelve, many of which had fawns by their side. A number of spike bucks were also seen that seemed to be of good growth. Evidence indicates that there still is an unbalanced condition of sexes.

By having the doe season, several natural results have occurred :

1. A number of bucks were permitted to live one year longer, with the result that a large number of deer with well formed antlers were noticeable to all hunters.

2. These bucks being present in the deer herd for more than a year, naturally afforded a larger number of doe to become bred, and a greater number were bred and more fawns were observed last spring. This was noticeable to us and the hunters, during the season, with whom we discussed this subject.

3. The bucks which were permitted to go over last season and which could have been legally killed in an open season are a representative male breeding group, and would naturally sire a stronger offspring than would older or even younger bucks. The question exists as to whether or not the spike buck is a sexually matured deer. This could be determined experimentally, and if definitely known, would be of considerable importance to the Game Commission, if conditions should some day arise when it was necessary to increase or decrease the deer herd. The deer herd may best be regulated in numbers by regulating the breeding. If an attempt of regulating the numbers on this basis was attempted, it would be necessary to know the breeding age of both the male and female of the species.

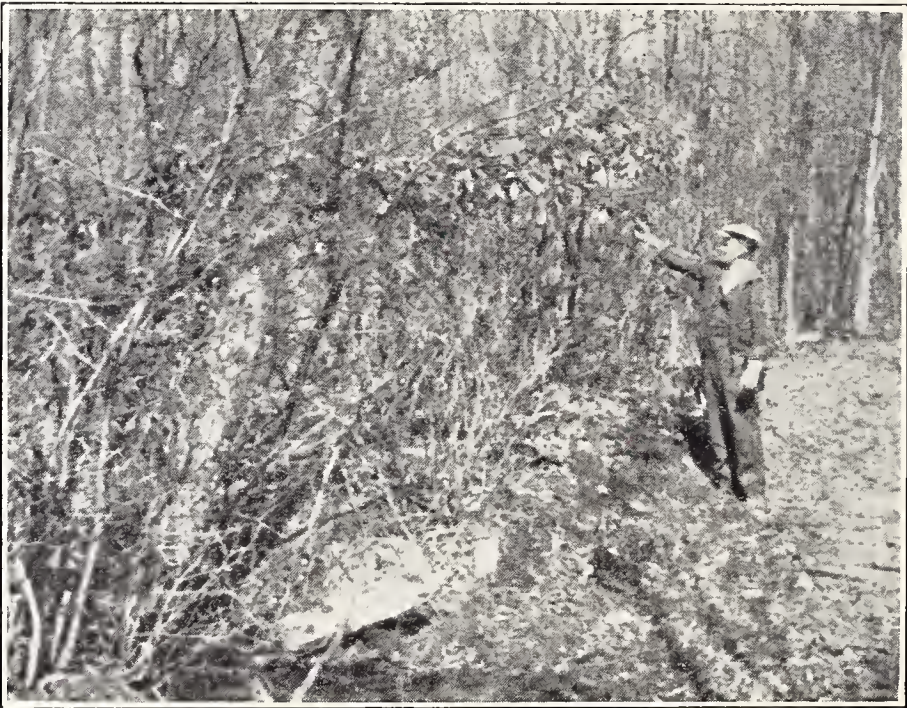
4. The deer herd of Pennsylvania in certain counties, and possibly the total of the State, is larger in number at present than it was a year or even two years ago.

5. The doe season, as some folk anticipated, did not reduce the deer herd in numbers. By the removal of a great number of old doe and by permitting the most virile group of young deer to remain in the woods to breed the more prolific female group, a more thrifty lot of offspring have resulted. With good food conditions, a larger deer would result from this culling method.

6. The hunters of Pennsylvania should welcome another doe season and a closed season on bucks. This will tend to help regulate the sexes and produce more deer for the State. One doe season is not sufficient to reduce the large percentage of females to males in the deer herd. Then after the doe were sufficiently reduced in number, for each

two open seasons on buck there should be one open season on doe. This would approximate the killing of two bucks to each doe.

In such counties where deer are less prevalent than in the heavy populated deer counties, it is suggested to increase the deer herd, that a closed season on buck be inaugurated for a year or so, as may be necessary to repopulate the county. This will do much to increase the deer herd. It is unfortunate that the deer of the heavy populated counties can not be removed to the less populated counties, also that they could not be removed to those counties where an abundance of food prevails.



SHOWING DEER LINE IN RHODODENDRON.

EXAMINATION OF STARVED DEER IN PIKE COUNTY, PENNSYLVANIA

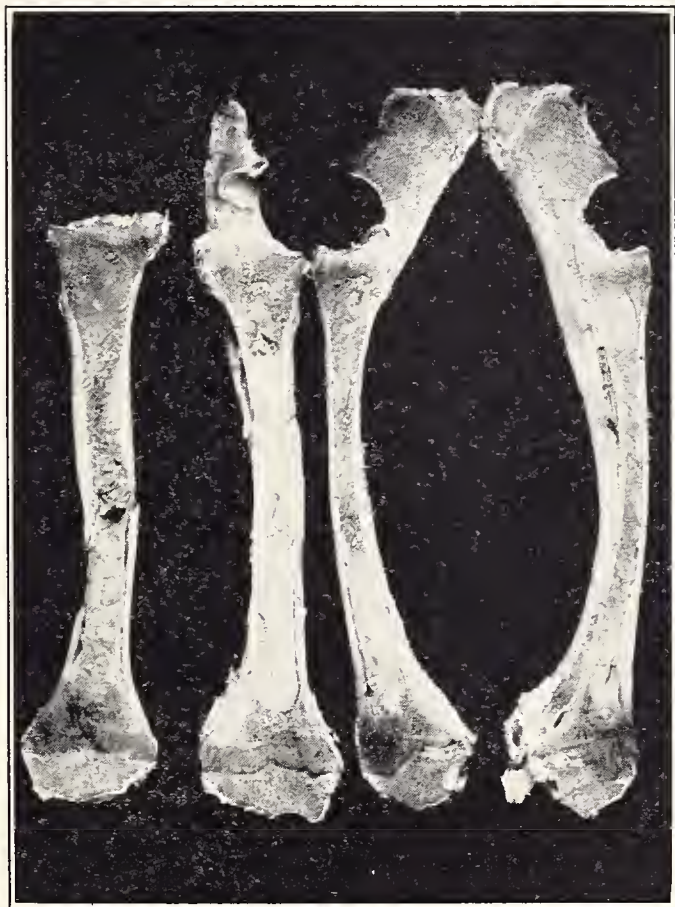
BY VERNON BAILEY

Chief Field Naturalist,

Bureau of Biological Survey, U. S. Department of Agriculture

On March 29th with John J. Slautterback, Executive Secretary, Board of Game Commissioners, Harrisburg, Pa., and Dr. Thomas E. Winecoff of the Board of Game Commissioners, and Dr. C. D. Marsh of the U. S. Bureau of Animal Industry, we drove from Harrisburg, Pa., to Milford in Pike County near where a considerable number of

dead deer had been found. The same evening we drove into the high forest some fifteen miles north of Dingman's Ferry, where we counted 61 live deer in about an hour before dark, mostly does, a few fawns, and one old buck. This was the only one that, in the absence of horns, could be surely identified as a buck.



ULNA-RADIUS OF YEARLING DEER, AFFECTED
WITH RACHITIS.

We examined several laurel and rhododendron swamps where the deer had yarded during the winter and had destroyed much of the best forage for themselves and the most desirable cover for grouse and snowshoe rabbits. No dead deer were found in this section but the forage was greatly overbrowsed and badly injured. Much of the laurel had been killed and the rhododendron was seriously injured; the sweetfern and blueberry bushes were reduced to stumps; the small pines were trimmed so that many would die, and the hemlocks showed a well defined and high deer line. Our unanimous conclusion was that there were too many deer for the food supply.

On March 30th we covered the Pine Flat country on the headwaters of Big Bushkill Creek in western Pike County where the deer had

been starving. At least 44 dead deer were found in this general area, including 42 last year's fawns, one buck, and one old doe. All of the fawns examined were extremely emaciated and had evidently died of starvation. Most of the deer had been dead for several weeks, but some had died more recently. Their stomachs were well filled with laurel or rhododendron leaves, dry oak leaves, some browse of blueberry and other shrubs, but all contents was low grade food with not sufficient nutrition to sustain life. Their muscles were pitifully shrunken around the bones and the hips and dorsal processes of the vertebrae were sharp and hard. In some the hind feet showed puffs and swelling that indicated rickets and further proved that starvation was the cause of death. The hearts and lungs and livers were healthy in appearance and the nasal passages were clear and apparently normal. We could find no other cause of death but simple starvation, or malnutrition from lack of suitable food.

All were found to be more or less infested with lice, *Tricholipeurus* sp., but not in sufficient numbers to have caused or contributed largely to the cause of death. Specimens of these lice were brought back and were identified by Dr. H. S. Peters of the Bureau of Entomology and proved to be the same as those found on the live fawns at State College in Centre County.

Many miles of swamp land and upland forest country were covered in searching for these dead deer, most of which had been already located by game protectors and forest rangers, and the forage conditions were carefully noted. Fifty-nine live deer were counted during the day, mostly does with a very small percentage of fawns, and no bucks that could be recognized as such. Tracks and trails and signs were abundant everywhere and all indications were that deer were too numerous for their own good or the good of the forest growth.

Most of the laurel and rhododendron over the Pine Flats area had been killed by having the successive growths of leaves and buds eaten until the plants died. A little very tall rhododendron in the swamps still had leafy tops above the reach of the tall deer but all the lower leaves were gone and most of these shrubs will die from too severe trimming. Blueberry bushes were closely browsed and many were killed. The hemlock had a very high and sharp deer line above the reach of the small deer. Even the scrub oaks were considerably browsed and there is very little good deer food left. The wintergreen is almost all gone and blueberry bushes are getting scarce. Small pines are nipped and many killed. The forest reproduction is arrested and the deer range is being ruined by an overstocking of does, many of which do not breed and if they do the fawns starve.

Pike County is one of those that in 1928 brought injunctions against shooting does and conditions have gone from bad to worse. Last

winter was comparatively mild with light snowfall. Otherwise there would have been a much heavier loss of fawns over a wider territory.

Half the does in Pike County should be killed next fall to adjust the deer herd to the food supply. As far as possible does without fawns should be killed but some fawns might also be killed, as many are sure to die during the winter. This would give a well balanced herd for the next year and probably allow the killing of bucks for several years before another doe season would be necessary.

Greater freedom for the Game Department in adjusting open and closed seasons on bucks or does in different counties as the local conditions seem to require would permit better game management throughout the State and a larger kill from a smaller herd of deer. Also it would prevent the destruction of young forest growth, now becoming serious, and the annoying depredations of deer on fruits and farm crops.



WHITE OAK SAPLING BROWSED BY DEER. (BY
COURTESY OF THE DEPARTMENT OF FORESTS AND
WATERS.)

These field investigations were followed up in every case with laboratory examinations of many carcasses by the trained specialists of the Pennsylvania Bureau of Animal Industry, and in every case confirmed the inevitable conclusion of death by simple starvation. Emaciation was so complete that in many carcasses of large last year's fawns, with no faintest sign of disease, not even chemical fat solvents could extract a hint of fat.

Including these forty-odd from a single locality, parties familiar with the situation estimate that fully one thousand deer died of starvation in this one county in one winter alone; though the north-western part of this county showed little overstocking with deer.

DAMAGE TO FARMS, ORCHARDS AND FORESTS

The damage done by deer driven by scarcity of their natural foods to destruction of farmers' and orchardists' crops, and the possibly greater damage done to both state and privately owned forests by over-browsing, has grown to be a very serious problem in many sections of the state, with no prospect of solution unless by reducing our deer herd.* And the fact that however serious this damage, and however much the board of Game Commissioners may sympathize with the victim who suffers it, no money compensation can be given, constitutes a very emphatic challenge to the sportsmen of the state and to Pennsylvania citizens in general to face this problem squarely as "a condition, not a theory."

SPECIAL DEER CONFERENCE

Impressed with the imperative need to do everything possible toward a speedy solution of this Pennsylvania deer problem, and to outline some definite plan of search for such a solution, the Board of Game Commissioners called a special deer conference for March 21, 1929, in the offices of the Game Commission at Harrisburg.

With representatives of the United States Biological Survey, the Pennsylvania State College, the Bureau of Animal Industry of the State Department of Agriculture, Bucknell University and other institutions present, several hours were devoted to a careful consideration of the Pennsylvania deer herd and its problems.

The nine Division Supervisors of the Game Commission attended and reported on conditions in their districts. W. Clair Kelly, Division Supervisor from Clearfield County, reported on the recent alarming mortality of deer in his section, stating that to date he had personally examined over 240 specimens. Following Mr. Kelly's statements as to food supply, the depth of the snow, and methods he had employed in attempting to feed the deer, the discussion was continued by Vernon

* See Department of Forests and Waters' Research Circular 3, "*Deer Damage to Forest Trees in Pennsylvania*," by LeRoy Frontz.

Bailey of the Bureau of Biological Survey, who carefully outlined the situation as he had found it in Clearfield County during his recent investigations. Mr. Bailey is convinced that the deer of Clearfield County have been dying of starvation, or *malnutrition*, a word which according to those present at the conference may be better understood by the general public. Stomachs of these animals held a good deal of material, but it is felt that this material contained little of *food value* and that, therefore, the animals were perishing from lack of nourishment.

An interesting report of the situation in the Kaibab Forest was given by Major E. A. Goldman of the Biological Survey, who in his capacity as Deputy in charge of Federal Refuges had made a careful study of the situation there. Dr. W. B. Bell, in charge of the Division of Biological Investigations for the Biological Survey, called attention to the foot-and-mouth disease epidemic in California which necessitated the killing of invaluable live stock and the slaughtering of over 22,000 deer. He also presented in brief outline some of the investigational work upon game animals that was being conducted by the Biological Survey and recommended that a definite program of investigation be outlined and conducted by the Game Commission aided by cooperators whose help could be enlisted to make field and laboratory studies to determine the essential facts.

It was brought out that very little is known concerning the food habits, the breeding period, period of gestation and other vital activities of the deer, and it was agreed by all that a careful, well-directed study of the animals should be undertaken during the coming months.

Professor Norman H. Stewart of Bucknell University, Lewisburg, discussed nasal myiasis among deer, as he has observed it in some specimens which he has examined. Professor Stewart is eager to carry on his study and hopes to find additional specimens which have in their nasal passages the larval stage of the parasitic fly which induces this disease.

The Game Commission is determined to make accurate studies of the deer, and field men have already been directed to cooperate to the fullest possible extent in forwarding specimens to Harrisburg or to other points where they are to be studied. * * * * * The fact that the United States Government has been so actively interested indicates that the problem is of nation-wide interest.

Those attending the conference were: Dr. W. B. Bell, Major E. A. Goldman and Mr. Vernon Bailey of the Biological Survey, Washington, D. C.; Dean R. L. Watts, Prof. R. D. Anthony and Prof. McIntyre of the Pennsylvania State College; Prof. Norman H. Stewart of Bucknell University, Lewisburg, and two of his student assistants; Dr. M. F. Barnes and Dr. A. L. Brueckner of the Bureau of Animal

Industry, Pennsylvania Department of Agriculture; Mr. G. H. Wirt and Mr. Roland of the Department of Forests and Waters; Game Commissioners Ross L. Leffler, Adolf Muller and Francis H. Coffin; Dr. Winecoff of Scranton, a naturalist who has studied conditions throughout the continent; the five Bureau Chiefs, nine Division Supervisors and the Trapping Instructor of the Game Commission. John J. Slautterback, Executive Secretary of the Commission, and Dr. George M. Sutton, Chief of the Bureau of Research and Information, were in charge of the conference.

Following this conference, a special "Advisory Committee" was appointed, "to act as a research and fact-finding body," consisting of:

Chairman—Dr. W. B. Bell, In Charge, Division of Biological Investigations, Bureau of Biological Survey, Washington, D. C.

Dr. M. F. Barnes, Director of Laboratory, Bureau of Animal Industry, Harrisburg, Pa.

Dr. B. Scott Fritz, Field Specialist, Bureau of Animal Industry, Harrisburg, Pa.

Dr. S. W. Fletcher, Director of Agricultural Research, State College, Pa.

Prof. Norman H. Stewart, Department of Biology, Bucknell University, Lewisburg, Pa.,

all scientists of prominence in similar lines of research.

NUTRITION TESTS

The Board of Game Commissioners, in hearty accord with the suggestions of the Advisory Committee, or fact-finding body, arranged with Pennsylvania State College for a series of nutrition tests of laurel and rhododendron as deer food, to be conducted under the authority and at the expense of the Game Commission by the Institute of Animal Nutrition and the Department of Dairy Husbandry of Pennsylvania State College, in consultation with the officers of the Board of Game Commissioners and the special Advisory Committee already named.

Dr. Forbes' report of these tests follows.

THE STATUS OF MOUNTAIN LAUREL AND RHODODENDRON AS FOODS FOR THE WHITE-TAILED DEER

By E. B. Forbes, Director of the Institute of Animal Nutrition, and S. I. Bechdel, Professor of Dairy Production, Pennsylvania State College.

The forests of Pennsylvania support an enormous herd of deer, which constitute a charming feature of the out-of-door life of the state, and also furnish sport for an army of hunters.

These deer, however, have become so numerous that they cause serious damage to field crops and orchards; and since they are capable

of carrying diseases of cattle and sheep, with which they mingle freely, they constitute a definite menace to the livestock industry of the state. So numerous, in fact, have the deer become in certain regions that the forest is cleared of every edible leaf and twig to a height as great as the deer can reach, thus forming a clear-cut "deer line" in the vegetation; and large numbers of young deer have died in these overstocked forests in the early spring during several recent years. This situation is also a matter for concern as it affects the sanitation of water-sheds.



FIG. 1. SHOWING DEER LINE AGAIN.

The Pennsylvania State Board of Game Commissioners, therefore, felt a need for full information as to the cause of the death of these deer, for its own guidance in the administration of the game law, and for the information of the people of the state, especially in order that hunters may be able intelligently to support the law. Accordingly the Board of Game Commissioners requested the Pennsylvania State College to determine, if possible, the cause of the death of the deer in the forests during the early spring, and especially to determine whether mountain laurel (*Kalmia latifolia*) and rhododendron (*R. maximum*) are poisonous to deer.

To provide for the accomplishment of this purpose, an experimental study was conducted at the College, in cooperation with the Board of Game Commissioners, the Institute of Animal Nutrition, and the Agricultural Experiment Station.

A feeding plant for the accommodation of this study was constructed on the College farm. About 4 acres of woodlot were inclosed, by means of 8-ft. woven wire fence, and divided into five long, narrow lots about

2 rods by 23 rods each in dimensions, and a larger nearly square "pasture"; a shelter shack was built for the storage of feed; and a small open shed was built in each experimental pen, to serve for the protection of the deer in stormy weather. The deer made almost no use of these shelter sheds, however, and even in cold and snowy weather preferred to lie out in the open.

During the summer of 1929 the Game Protectors of the state picked up the orphan fawns which came to their attention, and raised them on cow's milk for this study. As the fawns reached the weaning age, in the fall, twenty-two of them, and a yearling buck, were brought to the College, and became the subjects of this investigation.

In order that the fawns should have no feed other than that which was provided by the experimental program, all available browse was removed from the small, narrow feed lots in which the deer were confined, though an abundance of trees remained for shade, and the brush in the large lot which lay to the northwest of the smaller feed lots was not cut, and it served as an effective windbreak.

Milk was fed for a few days only, and then after a little "cutting and trying" to find out what the fawns would eat they were put on a ration of equal parts each of whole corn, whole oats, and pea-size linseed oil cake, with alfalfa hay for roughage. This proved to be an entirely satisfactory ration, and was used as a standard treatment at all times except when the fawns were on special experimental feed. No difficulty was experienced in feeding the fawns, and not one was ever sick while eating this standard mixture. They took to the grain ration without hesitation, and also liked the alfalfa. Their eating of this hay was very wasteful, however, because they carefully picked off the leaves, and *never* ate the stems. They would not eat appreciable quantities of either timothy or clover hay.

The reason for the study of laurel and rhododendron in relation to the death of the deer in the forests is that the stomachs of the dead deer are very commonly found to contain the leaves of these plants, in quantity, and that they have been known to be poisonous to cattle, sheep, and human beings for many hundreds of years,—at least since the days of Xenophon and Pliny, both of whom knew of their poisonous character.*

Inquiry among those who are in best position to know about the matter failed to bring to light information directing especial suspicion toward any other plant as the cause of the death of the deer. This phase of the problem, therefore, involved only the consideration of these two plants.

* Note: The most satisfactory review in English of the knowledge of the poisonous principle of the laurels (rhododendron is a laurel) is by S. W. Hardikar, "On Rhododendron Poisoning," *Jour. Pharmacol. and Exper. Therapeutics* 20, (1922), 17-44.

EXPERIMENTAL TREATMENT

On November 14 two of the fawns were shut up, one in each of two of the small shelter sheds. They were then subjected to a preliminary fast of 24 hours, after which one was given laurel, and the other rhododendron, for 5½ days.

On account of the confinement and the separation from their fellows both deer were exceedingly restless, and they ate very little of the feeds of interest. They preferred to eat leaf mold from the ground, dead oak leaves, and the woody branches rather than the leaves of the laurel and the rhododendron.

In both cases the deer showed aversion for the laurel and rhododendron leaves, and at the end of 5½ days were eating much less of them than at the beginning.

If either the laurel or the rhododendron was offered to a deer he would accept it, take a nibble, and then drop it,—never eating it entirely, and obviously not at all attracted to it. The average daily consumption of these feeds was in each case about 6 ounces of the fresh material per head per day (168 grams of the laurel, and 173 grams of the rhododendron). These quantities were equivalent to a very small fraction of a maintenance ration. No unfavorable effects were observed from the eating of these plants.

Between the dates of November 20 and November 25 (5½ days) nine deer were given laurel, and 9 others were given rhododendron, along with their customary grain ration, the deer having the free run of the feed lots as usual.

The deer which received laurel ate an average of 38 grams (1.3 oz.), and those which received rhododendron ate 61 grams (2.2 oz.), per head per day.

In other words, if the deer could have grain they would eat almost none of the plant materials of interest.

On November 22 a wild deer which had been injured by being caught in a wire fence in the Seven Mountains region was brought into State College, and was killed by a Game Protector to end its suffering. Its stomach was found to contain laurel and rhododendron alone.

Between November 26 and December 2 three deer were confined in each of two shelter sheds, one lot receiving laurel alone, and the other rhododendron alone, for the 6 days.

These deer ate much more of the plants of interest than did those previously confined singly, those receiving laurel eating 478 grams (16.9 oz.), and those receiving rhododendron 558 grams (19.7 oz.), per head per day. No unfavorable effect was noted. These fawns weighed about 50 pounds each, on an average.

An effort was then made to learn how much laurel and rhododendron the deer would eat if they were given these feeds with grain during

an extended interval of time, the idea being that under these conditions a developing sense of need of roughage might induce them to eat larger quantities.

Two lots of fawns, 8 in each lot, therefore, were given laurel and rhododendron respectively, with grain, but with no hay, from December 20 until February 13, a total of 49 days.

The animals seemed contented but lived mostly on grain, and ate very little of the feeds of interest. The conditions of weather, etc., were such that significant weights of the laurel and rhododendron consumed could not be determined. They ate about half as much again of the laurel as of the rhododendron, and ate more of both in cold than in mild weather.

During this time the fawns ate about 700 grams (1.5 pounds) of grain per head per day. They shivered in severe weather, but still preferred to be in the open rather than under the sheds provided.

On January 27 one fawn receiving rhododendron seemed out of condition. It staggered slightly as it walked, and its eyes looked dull. This appearance passed off, however, and did not recur during the later feeding of rhododendron alone. Otherwise no unfavorable effects of the treatment were noted.

On February 13 it was determined to make a long-time test of laurel and rhododendron alone. The grain, therefore, was taken away at once, and one lot of 8 fawns were given laurel and the other rhododendron.

After the withdrawal of the grain the fawns reversed their preference for the two feeds of interest, and began eating much more rhododendron than laurel.

On February 20 the lot which had been receiving laurel alone was given laurel and rhododendron, and thereafter ate mostly the latter, but continued to eat some of the laurel.

The two lots of deer were then continued on the treatments specified until March 29, making in all 45 days for one lot on rhododendron alone, and for the other lot 7 days on laurel and 38 days on laurel and rhododendron. No unfavorable effects were noted.

During the last two tests the 16 fawns in the two experimental lots received laurel, or rhododendron, or both, every day for 94 days, and during this period received no other roughage of any sort, except that the fawns did gnaw the bark from a few little wild cherry trees growing in their feed lots.

During the last 45 days, during which the fawns received laurel and rhododendron alone, and no grain, they became very thin and weak, and it was perfectly obvious that they were not eating enough of these feeds to maintain their weight. In order to have definite

figures to confirm this observation, the two lots of fawns were each weighed at the same time of day on March 20 and March 29.



FIG. 2. YEARLING DEER SUBSISTING ON LAUREL AND RHODODENDRON ALONE. A PILE OF BRANCHES FROM WHICH THE LEAVES HAVE BEEN EATEN IS SHOWN AT THE LEFT.

During these nine days the fawns which received laurel and rhododendron decreased in average weight from 59.1 pounds to 56 pounds, while the deer which received rhododendron alone decreased in weight from 52 to 49.75 pounds.

There was no appearance of poisoning, from laurel or rhododendron, but the deer had reached a very low state of vitality and of spirit. They acted more like undernourished calves than like deer, and in both of the experimental lots there was enlargement of the ends of the long bones of the legs—apparently incipient rickets—as a result of low calcium intake during the 94 days of underfeeding.

On March 29 the experimental treatment was discontinued, and the deer were restored to the stock ration of corn, oats, linseed oil cake, and alfalfa hay, with an additional allowance of mangel-wurzels. Also they were given the freedom of the large lot, in which they had access to normal browse. The improvement in the behavior of the deer was immediate, and within a few weeks they returned to normal condition.

Points worthy of note in regard to the method of the deer in eating laurel and rhododendron are that it is customary to eat the laurel more completely than the rhododendron; thus, in eating laurel a deer usually eats not only the leaves, but also the green stems of the preceding season's growth, and some of the ripe wood; while in eating rhododendron

the bud is the preferred part, the leaves frequently being cut off and allowed to fall to the ground,—the deer eating only the buds and green twigs.

Since the deer exercise a marked selective capacity in eating these plants, it is not easy to collect samples exactly representative of the feeds as eaten.

In Figure 2 the deer are shown subsisting on laurel and rhododendron. This illustration also shows piles of branches of these plants, from which the deer have stripped the leaves.

Late in April there was an interval of four days—the twenty-third to the twenty-sixth—during which the weather was stormy and unseasonably cold, reaching minimum temperatures of 23° F. and 22° F. on the twenty-third and twenty-fourth, respectively.



FIG. 3. HIND FEET OF YEARLING DEER,
AFFECTED WITH RACHITIS.

During this time the deer, which were in a low state of nutrition as a result of the previous confinement to laurel and rhododendron, suffered from the cold, and one died from pneumonia.

At this time a letter was received from I. H. Bartlett, of the Michigan Game Division, which seems to lend point to the above observation by reporting that veterinarians and other investigators of the deer yarding problem in Michigan had attributed cases of death of deer to pneumonia.

Also, late in April, it was observed that a number of the deer on experiment seemed to be becoming rickety, the most pronounced superficial symptom being enlargement of the fetlock joint.

In order to confirm this diagnosis, one deer was killed, and photographs are presented of the hind feet (Fig. 3), showing enlargement at the fetlock joint, and cross sections, sawed in two directions, of the metacarpus (Fig. 4), and the humerus (Fig. 5).



FIG. 4. METACARPAL BONE OF YEARLING DEER, AFFECTED WITH RACHITIS.

Superficial indications were borne out by the conditions revealed by the sectioning of the bones, and there is no question but that this deer was suffering from an early stage of rachitis.

Slight enlargement of the distal ends of the ribs was noted, and the ribs were so brittle that they could be broken with the fingers with

great ease; lymph glands were hemorrhagic, and petechiae of the tissues in general were conspicuous.

In order to extend this observation to the practical conditions of interest in the state, the Game Commission had sent to this institute, for examination, the cannon bones of four fawns which were found dead in the forest by John Lohmann, Game Protector, in Pike County.

In one case the bones were normal; in another the organic substance was too much decomposed for satisfactory examination; in another there was slight evidence of rickets; and in the fourth case there was moderate but unmistakable evidence of rickets.

Having definitely shown that deer are not visibly injured by the eating of laurel and rhododendron, even when forced to subsist on these plants alone, there remained the academic question as to whether deer can be killed by the force-feeding of these plants in larger quantities than are voluntarily eaten.

To determine this point a quantity of each of the plants was dried in an electrically heated air oven at a temperature of 60°C (140°F.), and were then finely ground, in a sample mill, as for chemical analysis.

As a means of administering these dried and ground leaves the authors adopted a painter's calking gun, which, so far as they know, is an original use of this tool, and mixed the dried and ground leaves with a sufficient proportion of cooked or uncooked flour paste so that it could be forced from the gun. The nozzle of the gun was extended 4 inches by the use of a rubber tube with an internal diameter of 5/16 inch,—by means of which the dose was placed in the back of the mouth of the deer, from which position the deer could not spit it out.

On April 29, after a preliminary fast of 24 hours, a fawn weighing 90 pounds was fed laurel leaf equivalent to 1.75 per cent (fresh basis) of the live weight; result, death.

On May 1 a fawn weighing 82 pounds, after a 24-hour fast, was fed laurel leaf equivalent to 1.29 per cent (fresh basis) of the live weight; result,—after four and a half hours, nausea, irregular respiration, much distress, and incoordination of movements, respiration rate 18 per minute; during the next three hours the pathologic symptoms increased in severity,—the animal *in extremis*; two hours and forty-five minutes later the fawn had improved in condition, pulse rate 40, respiration 35; regained normal condition within a few hours. The quantity of laurel fed was apparently about at the limit of toleration.

On May 8, after a fast of 24 hours, a fawn weighing 70 pounds was fed rhododendron leaf equivalent to 1.72 per cent (fresh basis) of the live weight. This quantity seemed to be as much as it could swallow. Two hours and a quarter thereafter the deer may have manifested slight nausea, but was alert and not definitely abnormal in any way, and no pathological symptoms appeared later.

On the same day another deer, weighing 58 pounds, was force-fed, at one time, 300 grams of oat feed, and 450 grams of wheat flour, plus water, in order to test the effect of the process of force-feeding on the animal. There was no unfavorable effect of any sort.

On May 29, a fawn weighing 74 pounds, after a 36-hour fast, was force-fed green rhododendron leaf equivalent to 2.25 per cent of the live weight; and a second fawn, similarly fasted, and weighing 57 pounds, was force-fed green rhododendron leaf equivalent to 1.35 per cent of the live weight. In both cases the ground leaf was mixed with raw flour and water to produce the consistency required; but in neither case was there any indication of poisoning or of other unfavorable effect of any kind.

CONCLUSIONS

Mountain laurel (*Kalmia latifolia*) and rhododendron (*R. maximum*) are eaten with considerable freedom by deer, especially in times of feed shortage; but as eaten seem not to be poisonous, as they are to cattle and to sheep.

Young deer, approaching one year of age, when held in confinement showed that they did not like laurel and rhododendron, and if allowed grain in addition would eat very little of these plants.

When restricted to laurel or rhododendron alone (without grain) the young deer would not eat enough of either to maintain the live weight.

Young deer were restricted to laurel or rhododendron and grain for 49 days. They remained contented and in good health. Then the grain was withdrawn, and the deer continued on laurel and rhododendron alone for 45 days. During this interval the deer became very thin and weak; they suffered from the cold, and one died from pneumonia; they also developed a mild condition of rickets, but did not exhibit symptoms of poisoning by the toxic principle of the laurel and rhododendron. Some evidence of rickets was also present in fawns found dead in the forest.

In the force-feeding of laurel leaf a deer was just able to tolerate and to recover from the effects of this plant in a quantity equal to 1.29 per cent of its live weight; another deer being killed by the force-feeding of 1.75 per cent of its live weight of laurel leaf.

The toxic principle of laurel and rhododendron, therefore, is poisonous to deer, though they seem not to eat, of their free will, enough of either of these plants to exceed their tolerance for this substance.

Three other deer were force-fed 1.35 per cent, 1.72 per cent, and 2.25 per cent, respectively, of rhododendron leaf, but in no case was there definite pathologic effect; rhododendron, therefore, seems to be less toxic than laurel.

In the light of the results of these experiments, supplemented by other published observations made by or for the Board of Game Commissioners, the usual chain of causes of the death of fawns in the forests of the state seem to be:—

The disturbance of the normal ratio of males to females among the deer, as a result of the greater protection which has been given the females by the law regulating the hunting of deer. This has the effect to delay conception by many does,—their young being born late, and coming into the winter too small to compete for food, on favorable terms, with larger deer.

These late fawns, therefore, are restricted, in seasons and in regions of feed shortage, to the less palatable and less nutritious feeds, especially to laurel and rhododendron; and under these conditions many have died, apparently as a result of malnutrition, cold, pneumonia, and rickets.

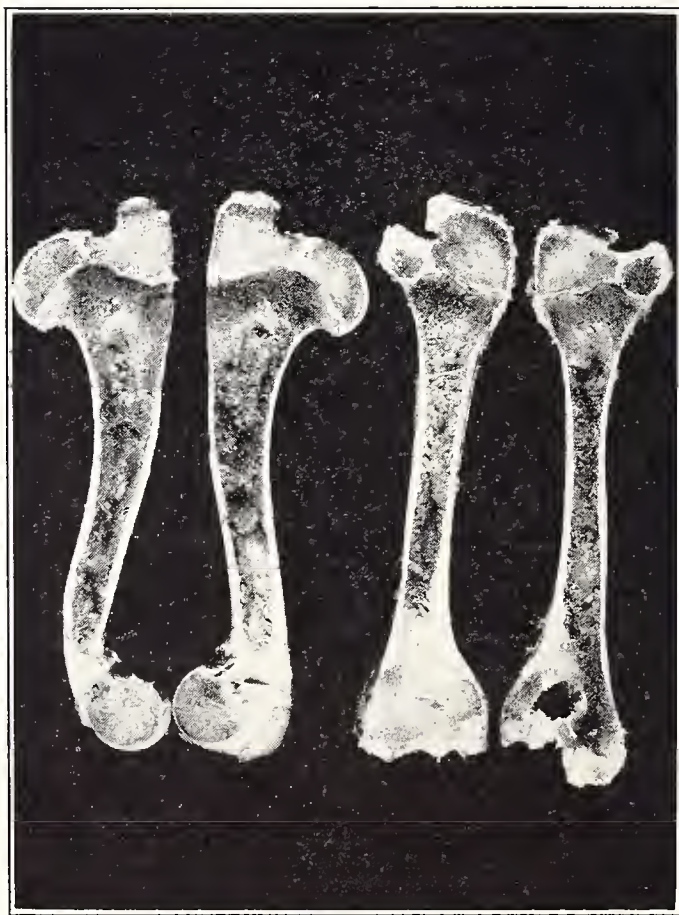


FIG. 5. HUMERUS OF YEARLING DEER, AFFECTED WITH RACHITIS.

ACKNOWLEDGMENTS

The writers wish to express their grateful indebtedness to Mr. John J. Slautterback, Executive Secretary of the Board of Game Commissioners, to Dr. Thomas E. Winecoff, who is in charge of the research work of this Board, to Mr. John B. Ross, Division Game Supervisor, and to Mr. Thomas A. Mosier, District Game Protector, for their generous support, advice and assistance in the conduct of this study; to Dr. C. Dwight Marsh, Associate Physiologist in the U. S. Bureau of Animal Industry, for suggesting the force-feeding of the deer, and the desage employed; to Dr. J. F. Shigley and to Associate Professor P. S. Williams for assistance in the force-feeding; and to Mr. John H. Smith for faithfully performing the principal part of the labor involved in this study.

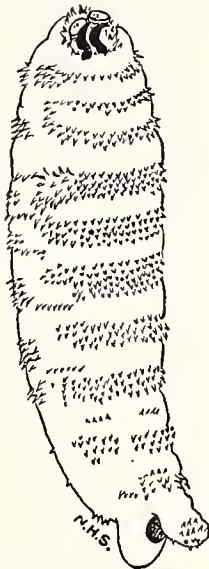
The net result of a statewide examination of the stomachs of deer coming into the hands of our field officers during last fall and early winter was to show that at that time, before normal deer food was exhausted, they were feeding on very little laurel and rhododendron.

NOSE FLIES

Dr. Norman H. Stewart, of Bucknell University, has continued his investigation of *Cephenomyia phobifer*, the nose fly which has been found infesting some of our deer, as well as deer and elk in other states, and caribou in Alaska; but these investigations have not been completed or extensive enough as yet for him to be willing to announce definite conclusions as to any part they may play in the high mortality among our deer. His preliminary report follows:

PRELIMINARY REPORT ON THE OCCURRENCE OF THE NOSE FLY (*Cephenomyia*) IN THE DEER OF PENNSYLVANIA

On April 20th, 1929, an Advisory Committee was appointed by the president of the Board of Game Commissioners to investigate the



Larva from Deer
Cephenomyia

causes of death among the deer of the state. I was asked to give attention to the parasite *Cephenomyia*. While this investigation may take much time before conclusions can be safely drawn, the following facts are significant.

On March 17, 1928, the first specimens of the larva of the nose fly were recovered from a deer found dead in the woods of Union County. This doe showed no marks of injury, though it was in very poor flesh. The nine larvae found in the nasal passage were preserved and identified as most probably of the species *Cephenomyia phobifer*.

It is not necessary here to describe the life history of this insect, as it is so closely parallel to that of the sheep bot fly with which most people are familiar. Sufficient to say that the adult fly deposits living larvae (maggots) in the nostrils of the deer in the summer and that they live in the upper rear part of the nasal chamber till the next April or May, when they are sneezed out and bury themselves under stones or leaves. There they undergo their metamorphosis in about thirty days and emerge as adult flies.

The assistance of the Board of Game Commissioners has made it possible for me to investigate a considerable number of deer, including those found dead in the woods, those killed by accident, and a few killed in the interests of this study. The fact that this larva crawls out of the head of a deer almost as soon as the deer dies makes collection of specimens very difficult. It is not surprising then that deer after lying dead a few hours show no parasites. (This should be remembered by any persons looking for this maggot). It was soon discovered (April, 1929) that the presence of the maggot or larva induces an inflammation in the mucous membranes of the nose and even in the envelopes of the brain. By this, one can tell if the maggots have been present, and so gain an idea of the prevalence of the parasite in any region. This inflammation causes a coffee brown color in the ethmoid region and a bright red or purple color farther forward in the nose. It is often more intense on one side than the other,—which shows that it is not a natural condition.

Up to the present date I have examined seventy-five deer. These have been sent from the following counties:

Clearfield	26
Union and Centre	43
Clinton	3
Sullivan	2
Tioga	1

The inflammation has been found in deer from each of these counties. This shows its extent in this part of the state, though it does not show

how much farther it may be spread. Of the deer examined thirty-five were so far decomposed that the inflammation could not be detected even if it had been present. But of the forty fresh specimens all but one showed more or less of the unnatural color. I am led, therefore, to conclude that our deer are badly infested with this parasite. Larvae have been found in fourteen deer, giving a total of fifty larvae so far recovered.

Reports from the Game Protectors who were asked to observe and report on the condition of the deer in their districts are as yet incomplete. Some who have been particularly interested have reported the symptoms mentioned above and have found in one case (Clearfield County) as high as twenty-four larvae in a single deer. Most have not come across dead deer up to the present.

It is too soon to judge the extent to which this parasite may directly or indirectly weaken or destroy our deer. Considerable literature has been gathered on conditions in other states and in Alaska and Canada. In Colorado deer have died at a feeding station and been found to have many of these maggots in the nose. The fact that we have found the inflammation about the brain suggests the indirect way the parasite may cause fatal disorders. As time passes it should be possible to determine the extent of weakness, discomfort, or death due to this cause. The case calls for the careful examination of deer each winter, the feeding of deer where congested, to see if they die in spite of food, and records covering years to show if the fatalities are epidemic, as most fly diseases are, or are directly related to food supply or some other condition. The study of *Cephenomyia* in Pennsylvania to date shows that many of our deer have this nasal parasite causing an inflammation close to the brain and with easy access to it. It remains for us to find out how much this disease disturbs the normal health of the deer or how far it may go as a contributing cause to their death.

The following quotations are included here to show what other investigators have concluded about this parasite in other localities:

1. C. R. Walker, Gunnison, Colorado.

"The deer were fed on the feed grounds, and had plenty of native hay put before them. It seems that *Cephenomyia* is the cause of the deaths, since so many deaths occurred in deer that should have been best able to meet other conditions and that should have profited most by plenty of feed. In all the autopsies I noticed the coffee brown color of the ethmoid region and the bright red inflammation farther forward.

The deer were very restless for twenty-four hours before their death. They were in almost constant motion. When they were down the head was drawn back and there was evidently much agony. I found that the larvae left the head as soon as possible after the deer died." There were about sixty

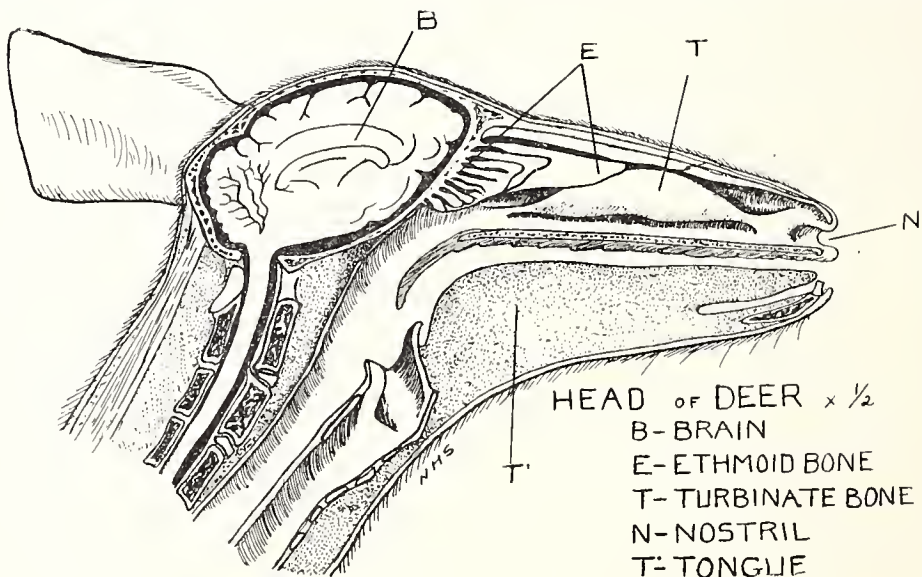
deaths at this place, some heads containing upwards of fifty larvae.

2. Dr. C. P. Fitch, Chief of the Division of Veterinary Medicine, University of Minnesota (quoting Dr. Gutschenritter, the veterinarian who sent him the specimens).

"The game warden of this district called me to examine a deer that was sick on April 1st. It was wandering around in a dazed condition. On April 3rd the deer had died. Post mortem findings: Very anemic. Lungs somewhat congested. Stomach contents normal. Colon somewhat reddened. On opening the head it was found that the region of the pharynx was highly congested, bloodshot. A number of the larvae were found in this region as well as in the nasal cavities."

In conclusion I would say that the investigation of this parasite is for many reasons difficult. Fresh material is almost essential. Again, the detection of the first stage of the larvae (one-fifth of an inch long) requires the boiling method and the use of the dissecting microscope. Also, unless the ethmoid bones are removed layer by layer the inflammation may be easily overlooked. To capture the adult fly is almost impossible, and various attempts to rear it have failed in this country. A few adults are in museums in this country, but "no American female flies are yet known in collections." (Townsend)

I would suggest, then, that if another season brings many cases of deer in poor and dying condition, the study be carried on in the very locality before the dead deer have time to decompose. Also that numbers of emaciated deer be shot for purposes of examination. This procedure would, I feel, give the best evidence of the actual condition of the herd in the late winter, and several related problems could be studied at the same time. The matter of food could be studied in-



tensively, the effects of low temperatures and snow, and the matter of diseases.

Respectfully submitted,
Dr. Norman H. Stewart,
Bucknell University,
Lewisburg, Pa.

June 24, 1930

UNBALANCE OF SEXES

So far, it is only a matter of utterly unreliable and inconsequential opinion as to the maximum ratio of does to bucks that will produce the best results,—nobody really *knows* anything about it; though the opinion of the most prominent naturalists is that it should not be greater than three to one, at most. A regrouping of our deer in captivity so as to provide for tests through future breeding seasons that will give at least an approximate answer to this problem is already under way.

But that there is a serious present unbalance with our deer in Pennsylvania must be manifest to anyone who observes them, even cursorily, in the wild. When a group of trained observers find only two antlered deer out of one hundred and seven (107), as on one occasion last fall, and only one set of antlers among sixty-odd, as on another recent occasion, to fail to recognize a serious unbalance would be the height of absurdity. And we have had some instances reliably reported that were even more extreme.

This exceedingly small ratio of bucks to does would of itself be enough to explain the amazingly small percentage of producing does, as found by actual examination of a very large number of does killed.

During the special season for antlerless deer in the fall of 1928 all field officers were instructed to send in all the female reproductive organs they could secure. And after that special season closed, many other sets of these organs were sent in for examination, both from does illegally killed and from those killed by authority of the Game Commission for the express purpose of laboratory examination.

Something like 650 were sent in all together, 616 of these sets being yet in such condition as to permit of thorough laboratory examination. These 616 were most thoroughly examined by specialists of the Pennsylvania Bureau of Animal Industry under the direction of Dr. M. F. Barnes. And of the 616 *just six* showed any evidence of pregnancy, even under the microscope,—LESS THAN ONE PER CENT!

Between Dec. 1, 1929, and Feb. 15, 1930, again twenty sets of these organs, from deer killed illegally or by accident, were examined in the same way, and JUST ONE found pregnant.

Again: this shortage of bucks has utterly deranged the natural and normal breeding season, so that three-months foetuses have been taken *six weeks after other does had given birth to healthy and evidently fullterm fawns*; and spotted fawns are frequently found even in the hunting season in December,—manifestly an effort of nature to compensate for the shortage of males by a prolonged or repeated mating season for the doe till she does—if ever—meet with a male.

These late fawns of course have far less chance of surviving the rigors and scarcity of food in their first winter, especially as the tenderest and most succulent foods have already been consumed by the older deer even before these have been weaned.

THE QUESTION

As the result of all these facts of observation and experiment, it is unmistakably plain that we must answer two main questions: Shall we reduce our deer herd to the carrying capacity of our range, or allow the farms, orchards and forests of the state to be destroyed, without possibility of compensation,—and a pitiful percentage of our young and growing deer die of starvation, after all? And WHICH shall we feed: growing fawns and bucks old enough for hunting, or a host of non-producing does (for *whatever* cause non-producing),—mere “boarders”?

These two questions, at least, MUST be answered, and answered SOON.

Compiled by Dr. Thos. E. Winecoff,
In Charge of Research,
Pennsylvania Board of Game Commissioners,
Harrisburg, Pa.,
August 5, 1930.

